Introduction

Welcome

Welcome to ControlSpace® Designer™ software, used for the set up, configuration and control of Bose® Professional system electronics. ControlSpace Designer software simplifies system configuration and programming through the use of standard drag and drop programming methods, and Smart Simulation, which allows you to instantly preview system programming without being connected to system hardware.

Click here to get started with the ControlSpace Designer help system.

ControlSpace® Designer™ 4.4 New Features Overview

ControlSpace® Designer™ software version 4.4 provides support for the following new products and features.

For additional information on fixes and enhancements in this release, see the ControlSpace Designer software version 4.4 release notes.

Training, application, and support

Additional information on the design, configuration, and control of systems using Bose Professional electronics, and the ControlSpace® Designer™ software can be found at pro.Bose.com.

A number of application examples are included with the ControlSpace Designer help system:

- City Council Chamber
- House of Worship
- Surround Sound Decoder
- Youth Multi-purpose Facility
- CobraNet Application Examples

The most recent application guides are always available at pro.Bose.com.

The ControlSpace User's Forum is a private forum for ControlSpace Users to share with other users, request new product features and functions, report issues with both software and hardware, and interact with the product development team. To join the ControlSpace User's forum go to proforum.Bose.com.

Getting Started

System Requirements

The following are the minimum system requirements for ControlSpace® Designer™ 4.4.

- Microsoft Windows® 7 and 8, x86 and x86-64bit versions (Windows 8 requires installation of Microsoft .NET 3.5)
- 1GHz processor (or better)
- 512MB of available RAM (1GB recommended)
- 512MB of available disk space (1GB recommended)
- Minimum resolution of 1366x768 WXGA
- 1 available USB port
- 1 available network port (Wired LAN, Ethernet, 100 Mb minimum; or wireless LAN 802.11g/n)
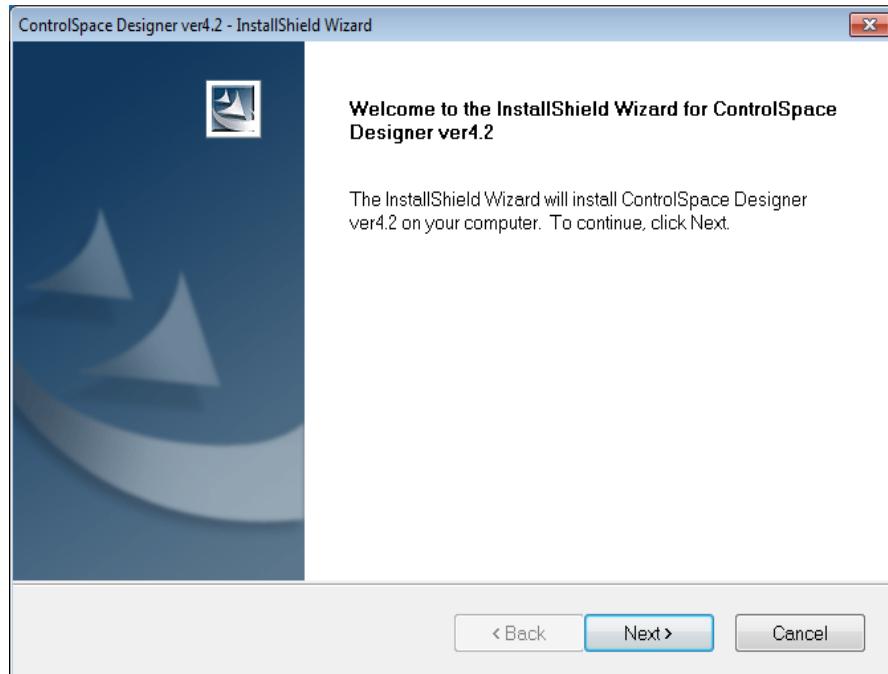
Software installation

The following redistributable software packages are required to properly run ControlSpace® Designer™ software. These files are included with the released software installation package.

- Microsoft® .NET™ Framework v4.5:
  (http://www.microsoft.com/en-us/download/details.aspx?id=30653)

- Microsoft® Visual C++ Redistributable Packages for Visual Studio 2013:
 (http://www.microsoft.com/en-us/download/details.aspx?id=40784)
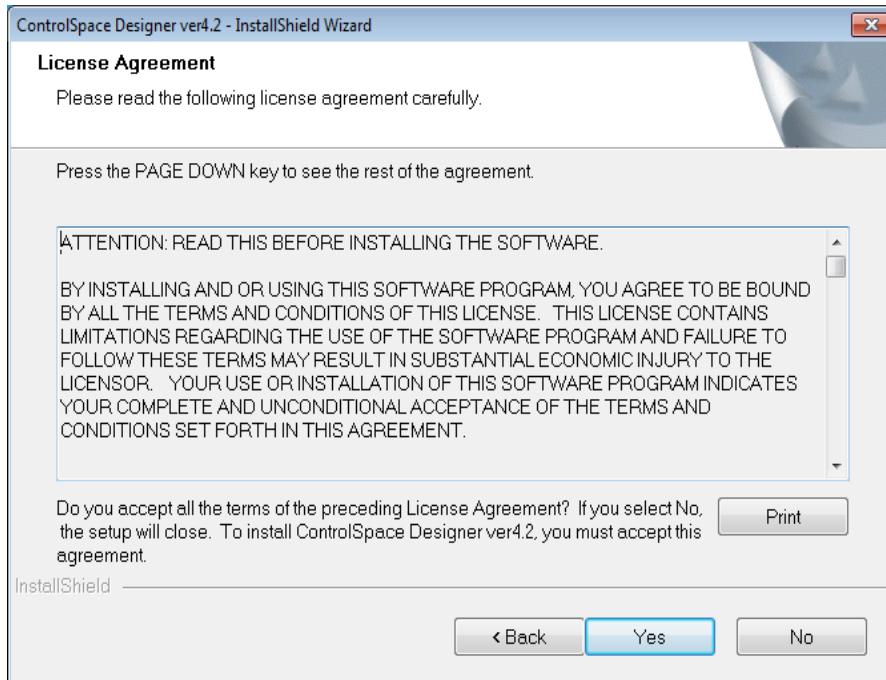
1. Double-click on Setup.exe to install ControlSpace Designer software.

   The Welcome dialog opens:
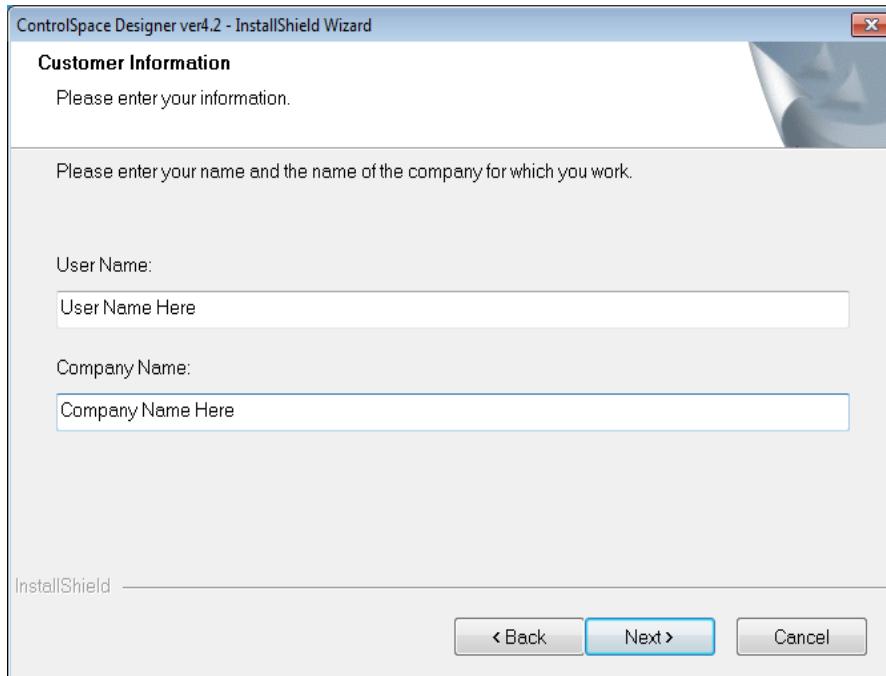
2. Click **Next** to begin installation.
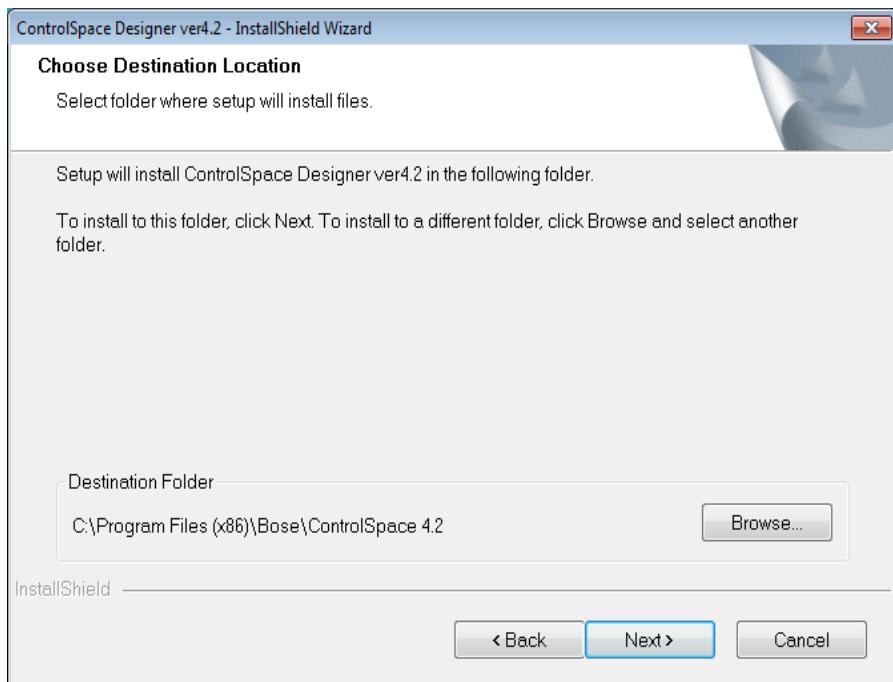
   The License Agreement dialog opens:

   ControlSpace Designer ver4.2 - InstallShield Wizard

   License Agreement
   Please read the following license agreement carefully.

   Press the PAGE DOWN key to see the rest of the agreement.

   ATTENTION: READ THIS BEFORE INSTALLING THE SOFTWARE.

   BY INSTALLING AND OR USING THIS SOFTWARE PROGRAM, YOU AGREE TO BE BOUND BY ALL THE TERMS AND CONDITIONS OF THIS LICENSE. THIS LICENSE CONTAINS LIMITATIONS REGARDING THE USE OF THE SOFTWARE PROGRAM AND FAILURE TO FOLLOW THESE TERMS MAY RESULT IN SUBSTANTIAL ECONOMIC INJURY TO THE LICENSOR. YOUR USE OR INSTALLATION OF THIS SOFTWARE PROGRAM INDICATES YOUR COMPLETE AND UNCONDITIONAL ACCEPTANCE OF THE TERMS AND CONDITIONS SET FORTH IN THIS AGREEMENT.

   Do you accept all the terms of the preceding License Agreement? If you select No, the setup will close. To install ControlSpace Designer ver4.2, you must accept this agreement.

   InstallShield

   [< Back]   [Yes]   [No]   [Print]

3. Read or print the License Agreement. Click the **Yes** button to continue.

4. Enter your name and company name in the Customer Information dialog and click **Next**.

   ControlSpace Designer ver4.2 - InstallShield Wizard

   Customer Information
   Please enter your information.

   Please enter your name and the name of the company for which you work.

   User Name:
   User Name Here

   Company Name:
   Company Name Here

   InstallShield

   [< Back]   [Next >]   [Cancel]
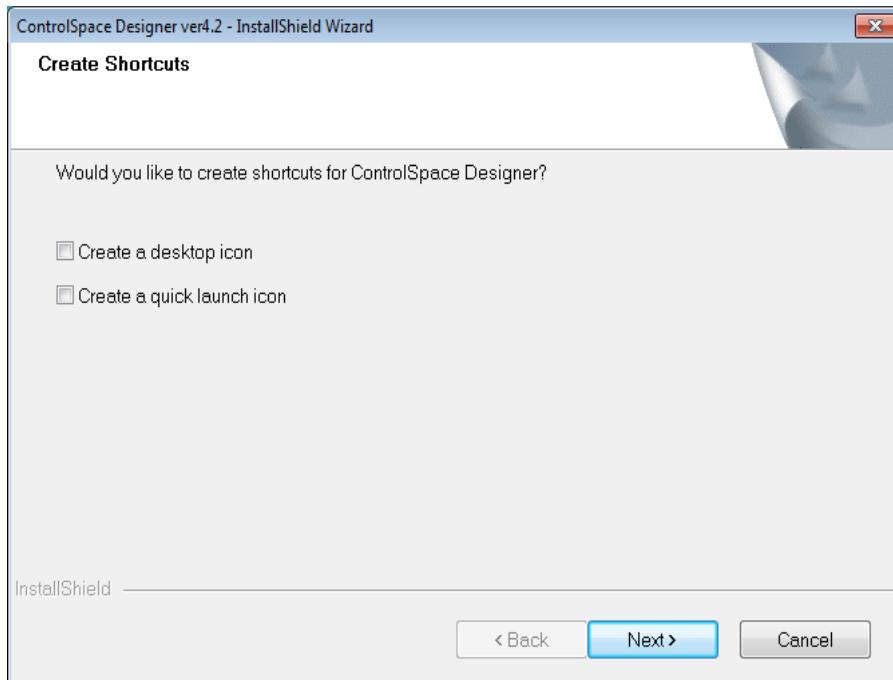
5. Select a folder for installing the software files and click **Next**.
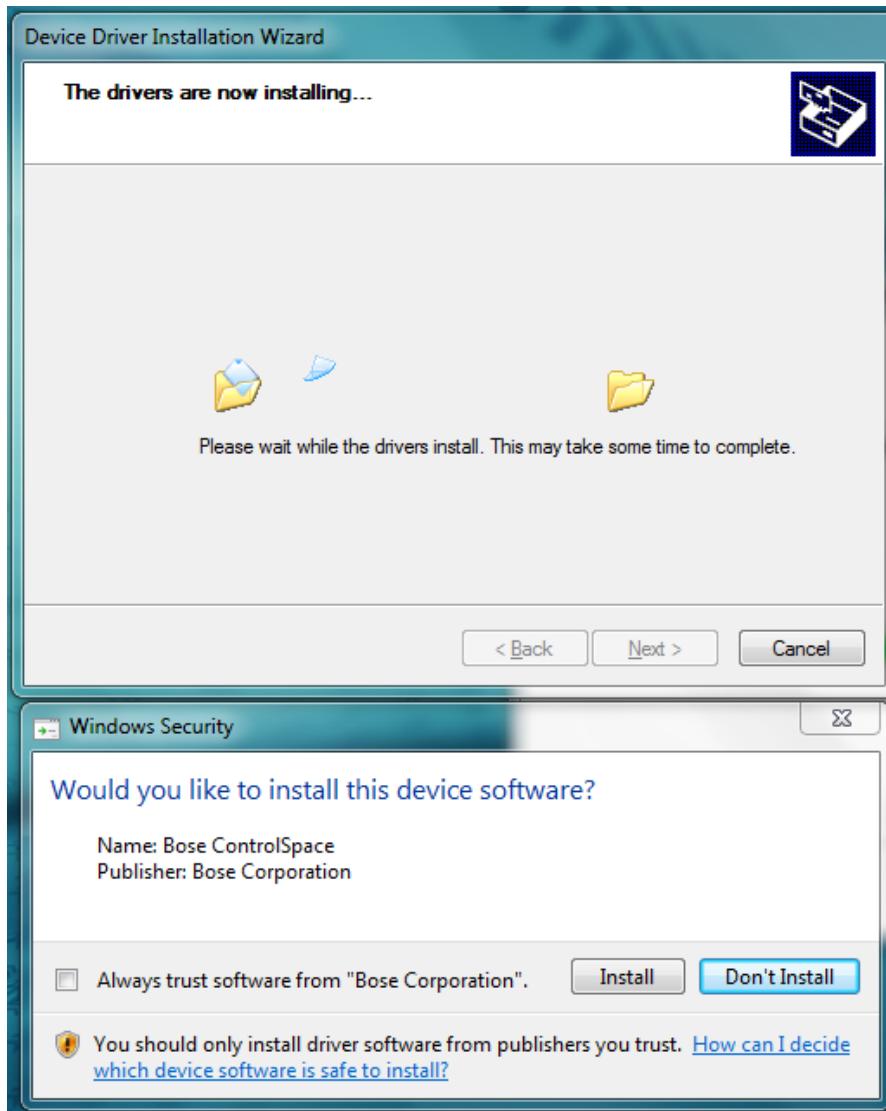

Software installation begins:
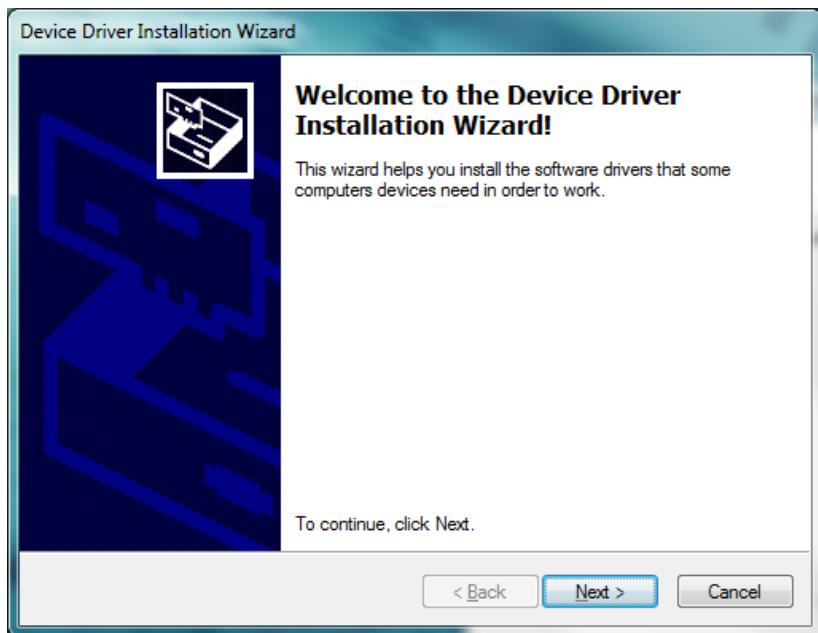
6. When prompted, specify what types of shortcuts to install.
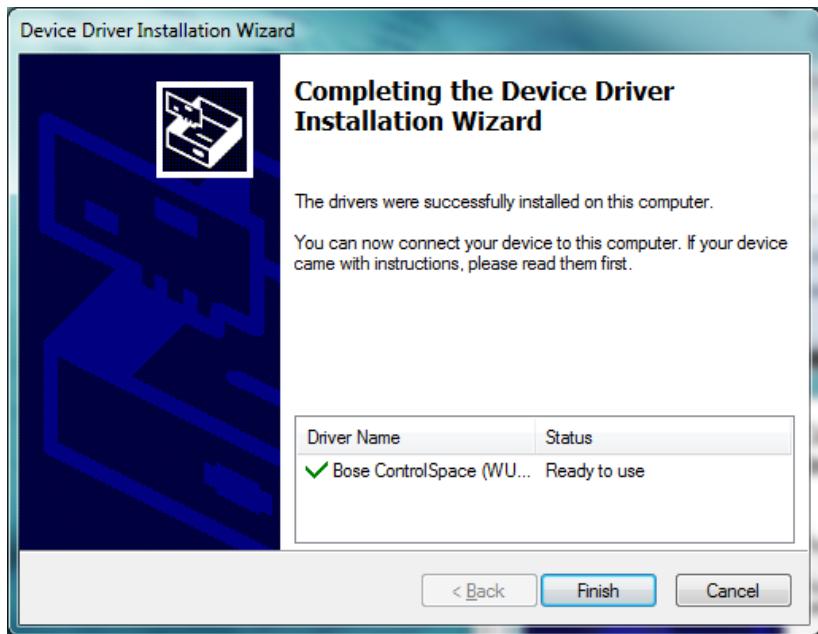
7. After driver software is installed, click **Install** in Windows Security dialog.
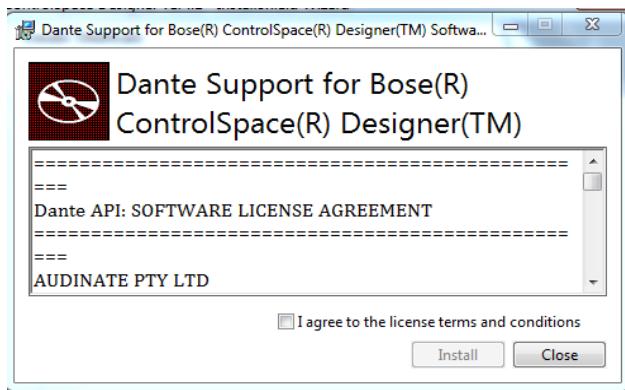
8. When the Device Driver Installation Wizard opens, click **Next** to install the drivers.
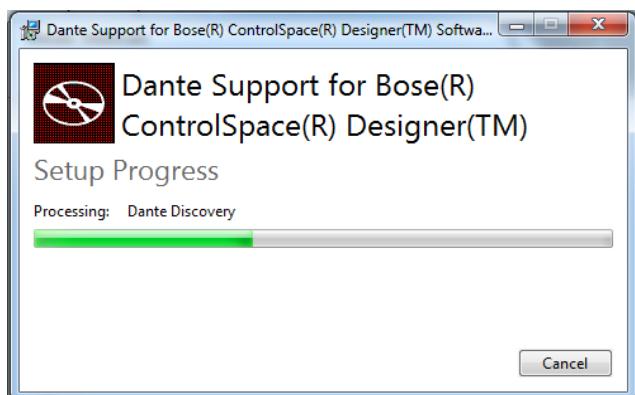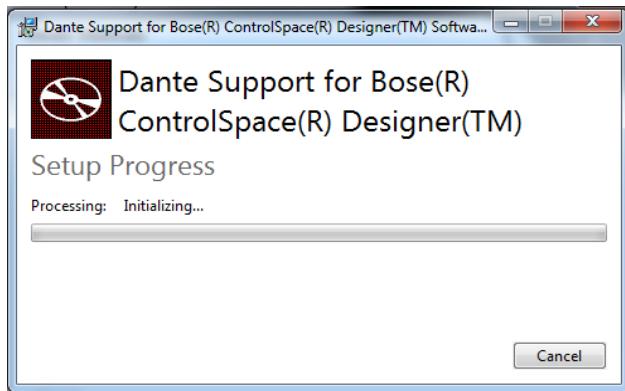
9. Click **Finish** to complete the ControlSpace software installation.
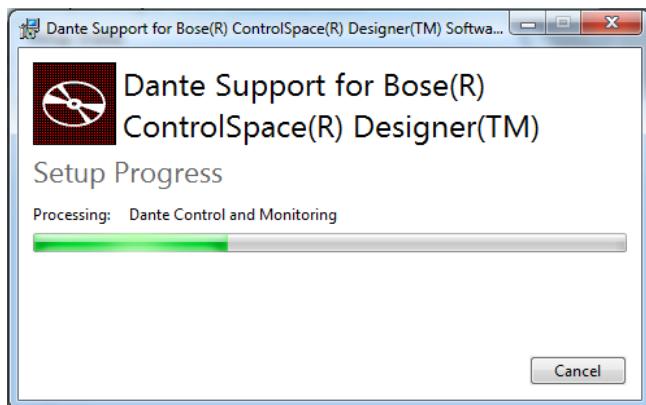
10. When the Dante support dialog opens, click the check box confirming that you agree with the license terms and click **Install**.
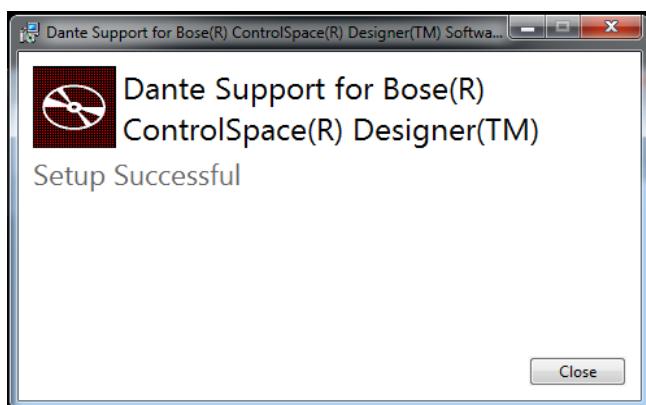
Verify that Dante Discovery and Dante Control and Monitoring are installed.
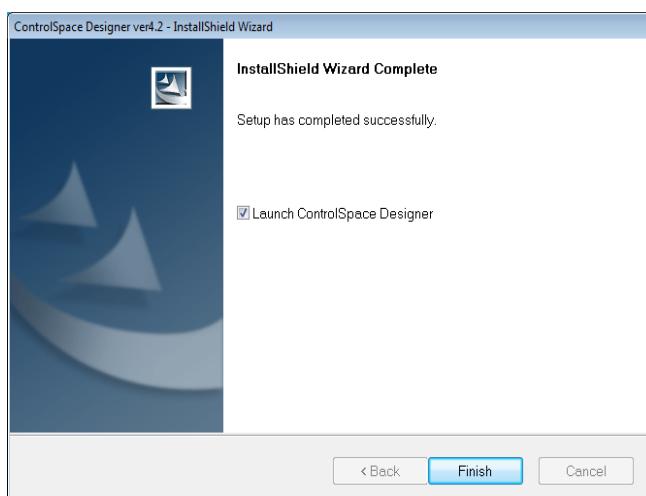
11. When the Setup Successful message appears, click **Close**.

12. Click **Finish** to close the installation wizard.

ControlSpace Networks

Working With ControlSpace® Networks

All ControlSpace® processors, networked user interfaces, PowerMatch® professional amplifiers, and the ControlSpace Designer™ software are pre-configured to operate on the same Ethernet network using standard Internet Protocol (IP) addressing. The addressing of devices within a design is managed automatically according to the currently defined Project Network Address and the type of device.
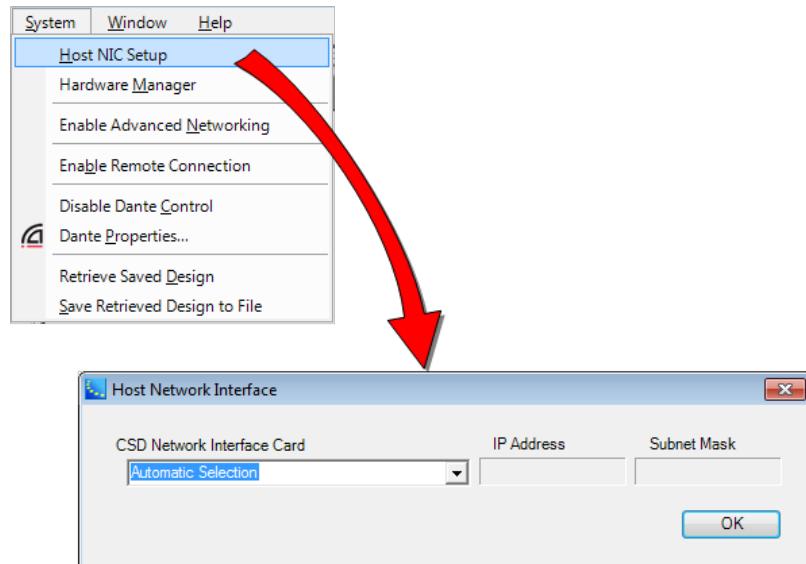
By default, the Project Network Address is set to 192.168.0 with a subnet mask of /24, or 255.255.255.0. When connecting to the network, the ControlSpace Designer (CSD) Network Interface Card (NIC) is selected automatically unless you have specifically selected one since the CSD software was installed. Normally, the NIC is set up on your computer to match the default project mask and address in the expected range, say 192.168.0.10, and connect to devices via that NIC.

When connecting to a device for the first time you will need to set your PC's IP address to 192.168.0.xx, and verify that ControlSpace Designer software is using the 192.168.0.xx Project Network Address. Once this is done you can easily connect to any new ControlSpace Network devices (ESP signal processors, CC-64s and PowerMatch amplifiers) and configure them for operation.
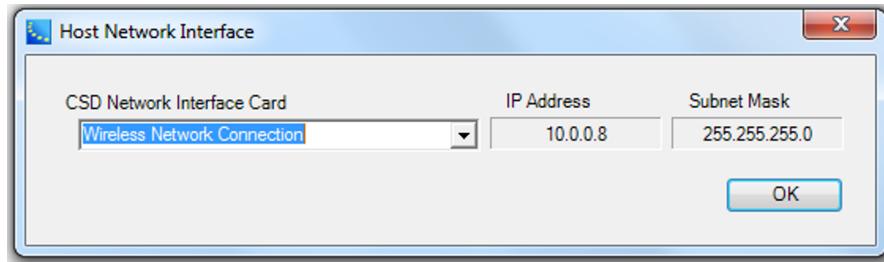
Host Network Interface

The Dante subsystem requires a NIC name at launch, so if no NIC is specified, the name of a NIC that matches the project address and mask is automatically used.

If a wireless NIC, (or multiple NICs) also resides on the computer, but is not intended to be used, it may interfere with network communication, with communications routed through that NIC instead of the intended NIC. In this case you must explicitly select the intended NIC in the **Host NIC Setup** Dialog via the **System** menu. Once selected, the NIC is saved with the CSD installation, retained and reused across CSD sessions.

Opening the Host Network Interface dialog

Identifying the project NIC

When a NIC is selected, it is always saved to the Settings.xml file and restored on every CSD launch. The selected NIC is used for all communications to the network. In the case where no NIC has been selected since installation of CSD, the NIC is selected automatically to match the project address. When selected, project devices are unaffected as the NIC is independent from the Project Network Address.

Managing device addresses

As new devices are added to a design they are automatically given an IP address according to their device type and the currently defined Project Network Address. As additional devices of the same type are added the device address octet is incremented to prevent duplicate IP addresses being added to the design.

Bose network electronics all ship using a predefined IP address according to their device type. When you are using more than one of any type of device on the network you will need to configure the IP address for the devices on the network individually using the Network Setup function within ControlSpace® Designer™ software.

The following table shows the pre-assigned IP address for each device type, and the automated addressing range used when multiple devices are added to the system design:

Device IP Addresses
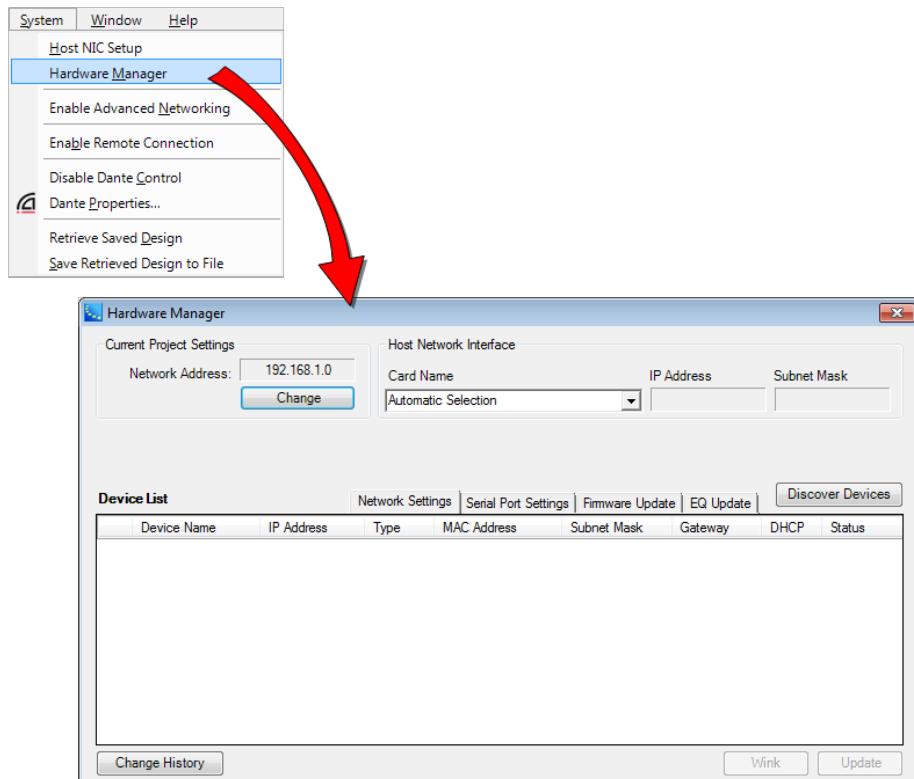
Device	Default Hardware Address	Address Range
ESP-00 II ESP-880/1240/4120/1600	192.168.0.160	160-175
PM8500N/PM8250N	192.168.0.80	80-159
PM4500N/PM4250N	192.168.0.40	40-79
CC-64	192.168.0.176	176-207
System PC	192.168.0.10	N/A

NOTE: It is not necessary to have a Project open within ControlSpace Designer to change IP addresses. However, the address you assign to the devices should be consistent with the addresses in your design.

Hardware Manager
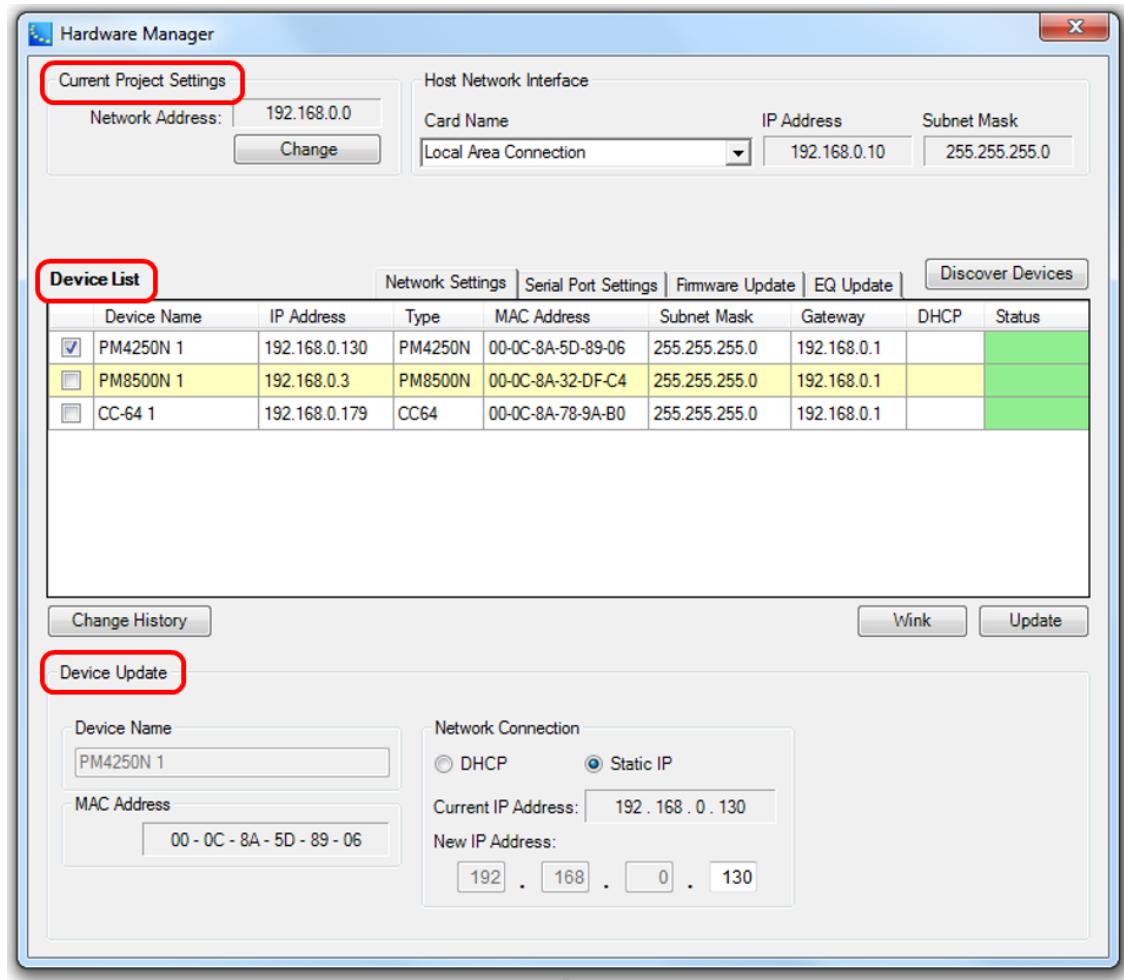
Launching the Hardware Manager

The Hardware Manager dialogs are used to set the project network properties, to set device network properties, and to upload EQ files to Power Match devices. To launch the Hardware Manager, click **Hardware Manager** in the **System** menu.

Upon launch of the dialog, a scan is performed to discover devices that answer the Broadcast scan, and are within the project network.

NOTE: When launching the Hardware Manager, the Dante network polling is suspended, as is consistent with previous behavior when launching Network Setup or Firmware Update. This means that any Dante endpoints will vanish from the project view until Dante communication is reestablished.

Three Sections of Hardware Manager Window

The Hardware Manager comprises three stacked sections of data.

Current Project Settings - The top section displays the project address and subnet mask. For convenience, the current NIC settings are also displayed for comparison.
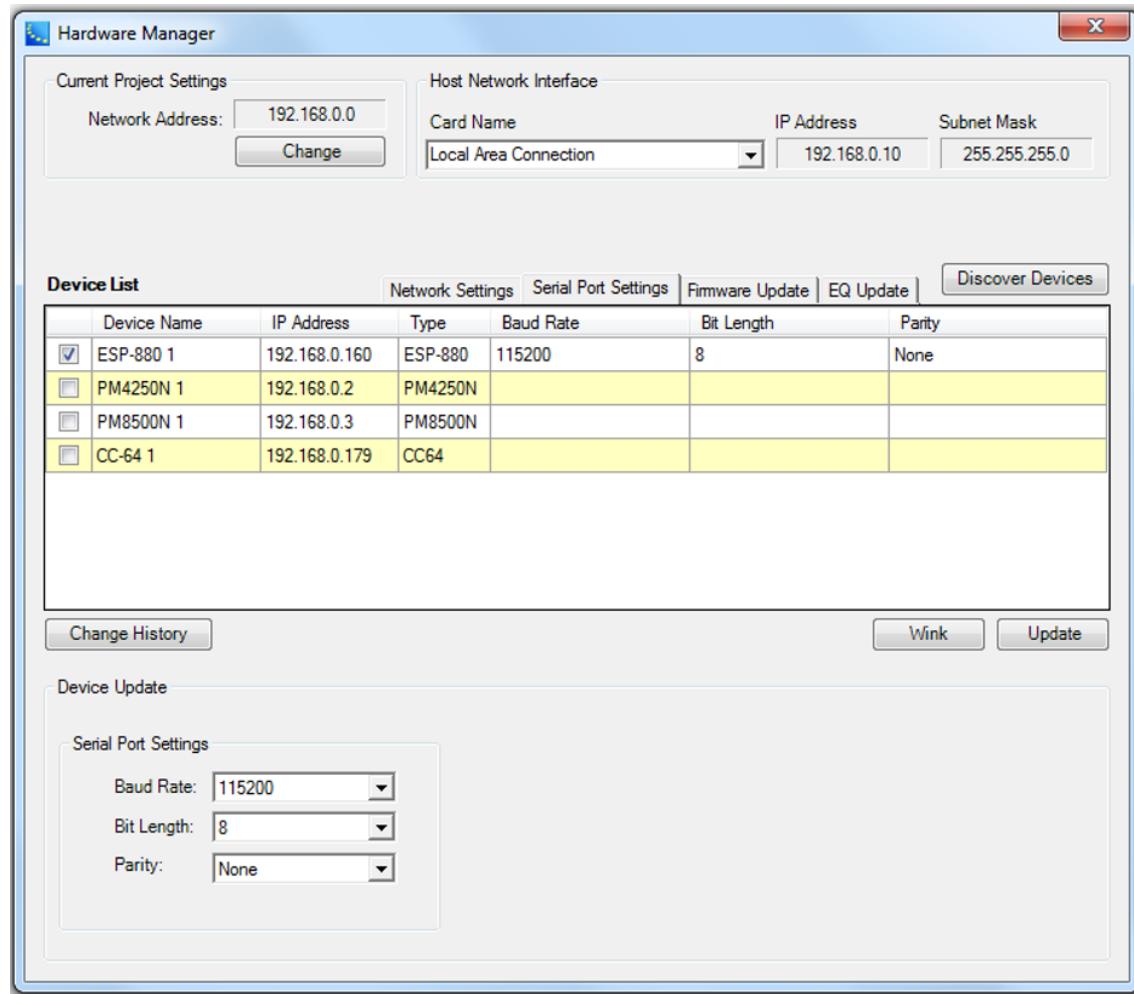
Device List - The middle section contains the list of devices that are discovered on the project network, and is always visible. There are four tabs included in this list: the "Network Settings" tab, the Serial Port Settings tab, the Firmware Update tab, and the EQ Update tab. For convenience, the **Discover Devices** button allows you to rescan at will, which is useful when confirming changes to hardware device properties or discovering devices that have been connected after launching the dialog. PowerMatch® non-networked devices are not included in the list.

Device Update - The lowest section is used to set device properties, but is only displayed for the Network Settings and Serial Port Settings tab when a single item is selected in the device list that has properties you can modify.

Device List Tabs
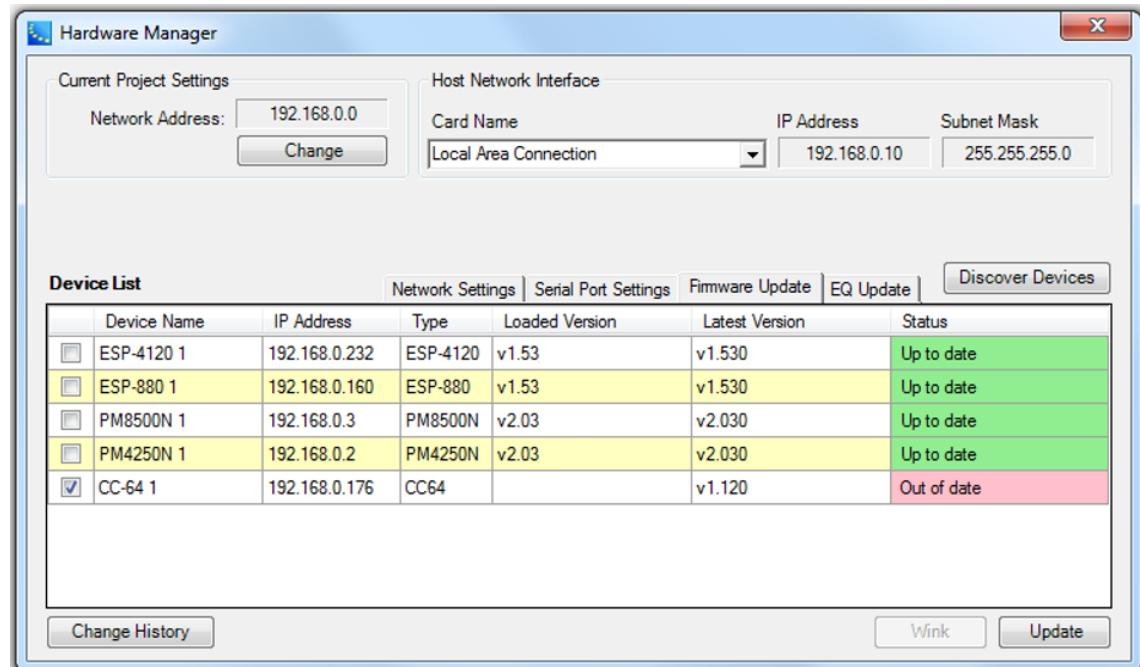
The **Device List** contains multiple tabs, including the Network Settings, Serial Port Settings, EQ Update and Firmware Update. A **Wink** button and an **Update** button are included to identify and change device properties, respectively. **Wink** is only enabled when a single device is selected that supports wink, including ESP-00 II and PowerMatch® amplifiers.

In the following view, one device within the **Serial Port Settings** tab has been selected. Its serial information is shown in the Device Update section of the dialog. Note that only ESP devices support serial communication and can be selected.
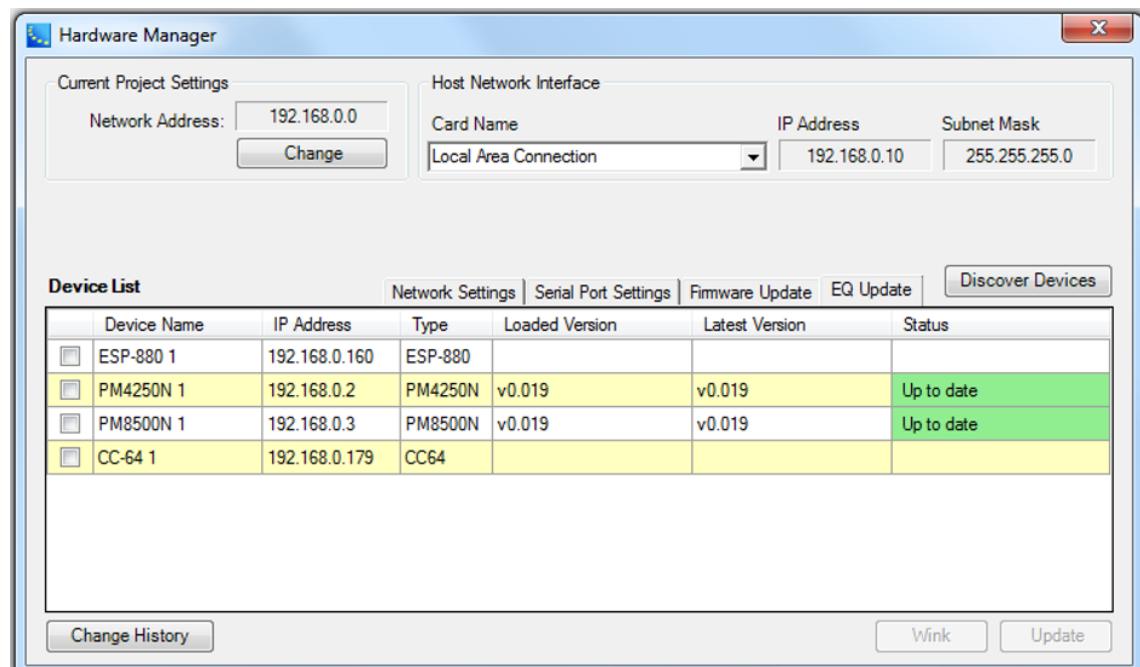

Serial Port Settings Example

Selecting the **Firmware Update** tab displays the Loaded Version, Latest Version, and Status for the listed devices. This view supports multi-select, and automatically selects all devices with out-of-date firmware files (highlighted in pink). Clicking the **Update** button sequentially sends a new firmware file to the selected devices. Upon completion, the status column is modified accordingly.

Hardware Manager

Current Project Settings
Network Address: 192.168.0.0
Change

Host Network Interface
Card Name: Local Area Connection
IP Address: 192.168.0.10
Subnet Mask: 255.255.255.0

Device List — Network Settings | Serial Port Settings | Firmware Update | EQ Update — Discover Devices

	Device Name	IP Address	Type	Loaded Version	Latest Version	Status
☐	ESP-4120 1	192.168.0.232	ESP-4120	v1.53	v1.530	Up to date
☐	ESP-880 1	192.168.0.160	ESP-880	v1.53	v1.530	Up to date
☐	PM8500N 1	192.168.0.3	PM8500N	v2.03	v2.030	Up to date
☐	PM4250N 1	192.168.0.2	PM4250N	v2.03	v2.030	Up to date
☑	CC-64 1	192.168.0.176	CC64		v1.120	Out of date

Change History | Wink | Update

Firmware Update Tab Example

Selecting the **EQ Update** tab displays the Loaded Version, Latest Version, and Status for the listed devices. This view supports multi-select, and automatically selects all devices with out-of-date EQ files (highlighted in pink). Clicking the **Update** button sequentially sends a new EQ file to the selected devices. Upon completion, the status column is modified accordingly.

Hardware Manager

Current Project Settings
Network Address: 192.168.0.0
Change

Host Network Interface
Card Name: Local Area Connection
IP Address: 192.168.0.10
Subnet Mask: 255.255.255.0

Device List — Network Settings | Serial Port Settings | Firmware Update | EQ Update — Discover Devices

	Device Name	IP Address	Type	Loaded Version	Latest Version	Status
☐	ESP-880 1	192.168.0.160	ESP-880			
☐	PM4250N 1	192.168.0.2	PM4250N	v0.019	v0.019	Up to date
☐	PM8500N 1	192.168.0.3	PM8500N	v0.019	v0.019	Up to date
☐	CC-64 1	192.168.0.179	CC64			

Change History | Wink | Update

EQ Update Tab Example

Batch Mode

CSD software supports a Batch Mode for updating multiple devices with a single button click. In the illustration below, the project address has been changed from 192.168.0 to 192.168.1, placing each networked device outside the project. Note the status column to the right. The devices that fall outside the project are automatically preselected when opening the **Network Settings** tab. The **Batch Update** section at the bottom of the dialog shows a row entry for each selected device, and the data that places it outside the project is indicated in pink. Gateway values that are not a match with the project are indicated in goldenrod yellow.

NOTE: IP addresses are changed only if outside the selected subnet.

Dialog for Batch Mode

While the target IP address for each selected device cannot be explicitly set, a starting IP address is indicated, and each newly generated IP address is an increment from the initial seed value (192.168.1), skipping over IP addresses that are already in use on non-selected devices.

The **Change History** button launches the following dialog containing an entry for each change to a device network property to help keep track of their current IP, subnet and gateway state.

Properties Dialog launched by Change History Button
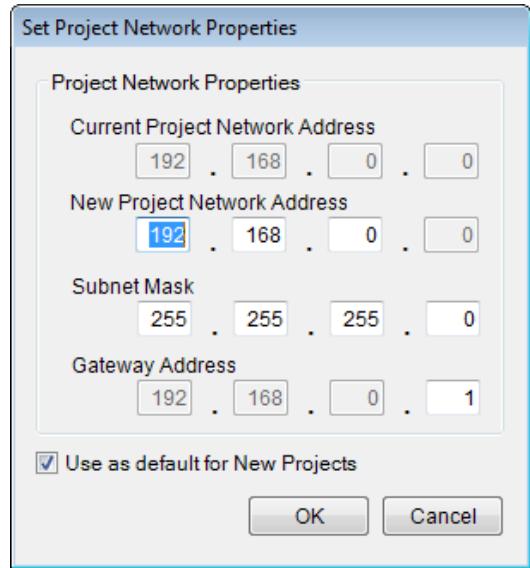
The **Current Project Settings** section contains access to the **Set Project Network Properties** dialog via the **Change** button. The dialog initially contains CSD default values which can be modified using the New Project Network Address field. By checking off the "Use as default for New Projects" box the same setting will be used for new projects.

Normally, only the project address would be altered although the Subnet Mask area can also be modified.

Whenever the project network properties are modified, all SW devices in the project are automatically modified to conform to the new values. To transfer these new settings to the hardware devices, the **Device List** and **Device Update** sections on the Hardware Manager dialog are used.
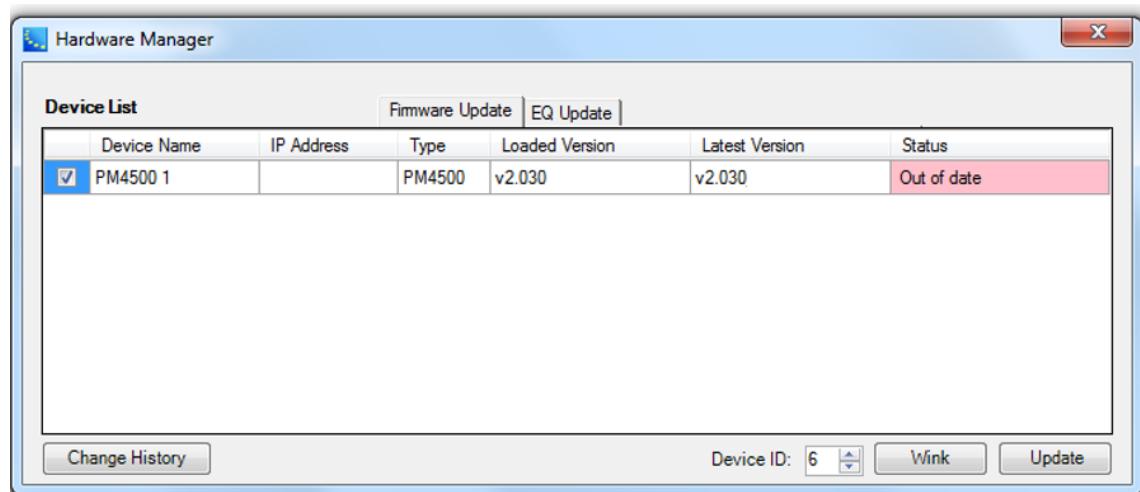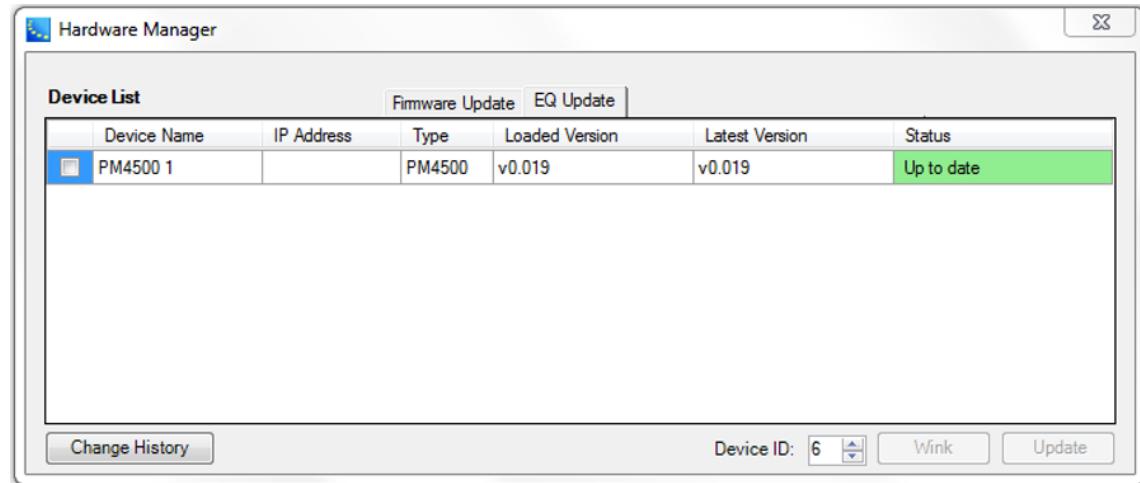

Set Project Network Properties Dialog

Set Project Network Properties Dialog
(Advanced Networking enabled)

Non-Networked PowerMatch Devices

When connected via USB to a non-networked PowerMatch device, only the EQ and Firmware Update tabs are available. To change the device ID, use the **Device ID** setting at the bottom of the dialog. When making changes that require a reboot, as in firmware or device ID, the dialog is dismissed upon completion.

Network Scan

The Network Scan function can determine which devices are currently active on the ControlSpace® network, without actually connecting to the system. In general, the Network Scan should only be used with a new, blank project as a means to identify what hardware already exists on the local network as the Project View will be populated with these devices.

NOTE: The Network Scan only retrieves device configuration information and does not include any signal processing or control programming information stored within the device.
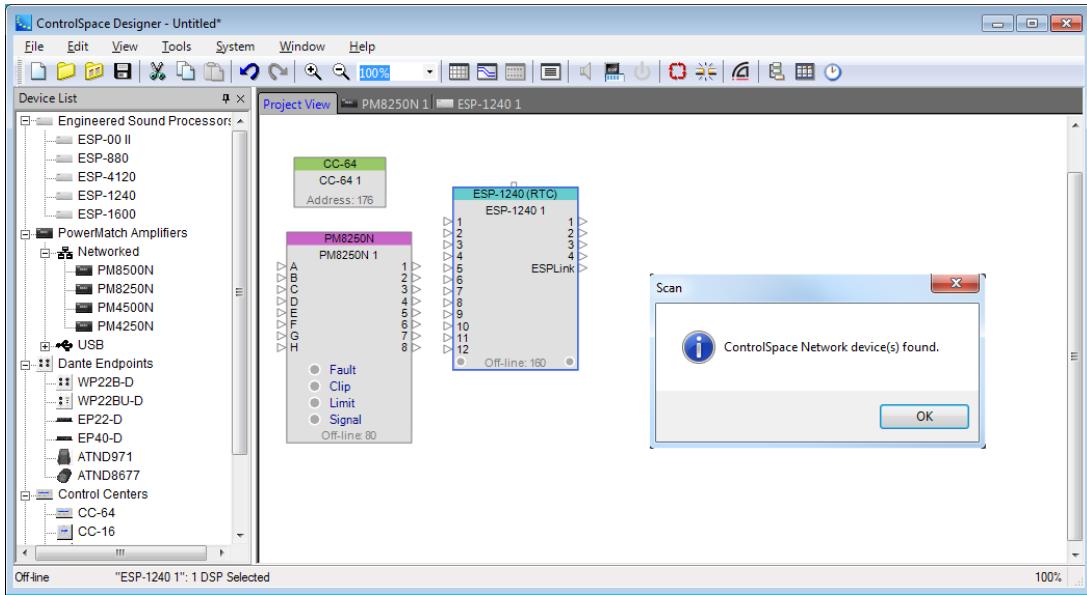
The following steps describe how to use the Network Scan function:

1. To identify the devices on the network, go to the main toolbar and click the **Scan** button (or press Alt + T, S).


Location of Scan button

2. Select Scan to search the network for active Bose networked devices. Once the scan is completed the Project View is automatically populated with the devices in your local network.

Scanning for devices

Error Messages
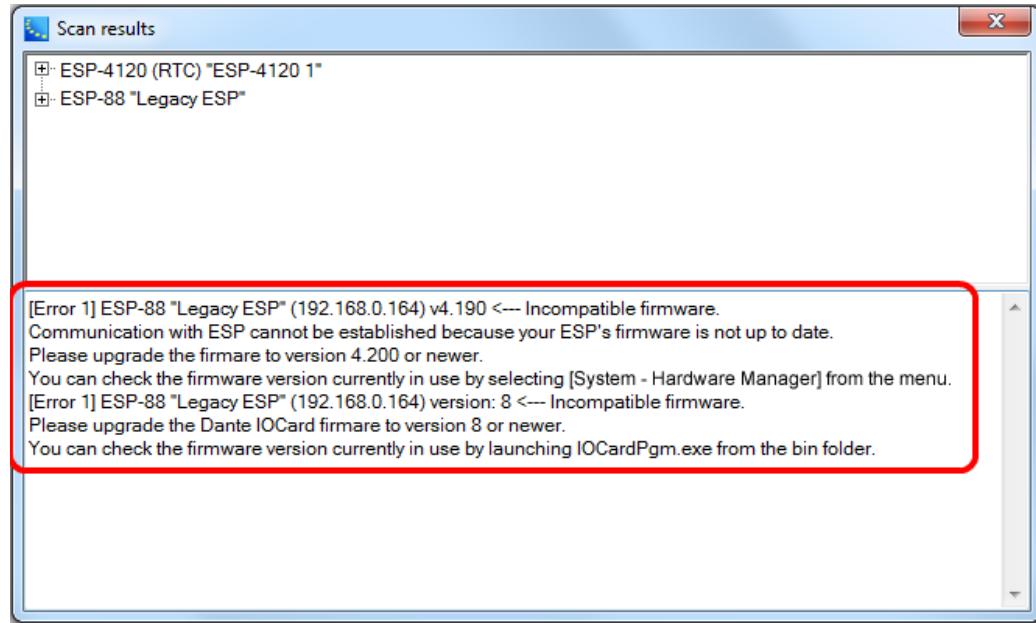
If no devices are present on the network you will receive an error message stating that no devices were found:

No devices detected message

In this situation, verify that the devices are powered on, and that the PC IP address and the Project Network Address within ControlSpace® Designer™ software are configured for the same primary network addressing scheme as the hardware.

When performing a Network Scan, additional errors may be generated notifying you of the need to update device firmware and EQ database files.

Incompatible firmware message

When performing a Network Scan with devices already added to the project, the following additional errors may be generated:

- Configuration Mismatch
- Devices Not Found

Remote Network Control

ControlSpace networks can be operated using remote devices via a router-to-router connection.
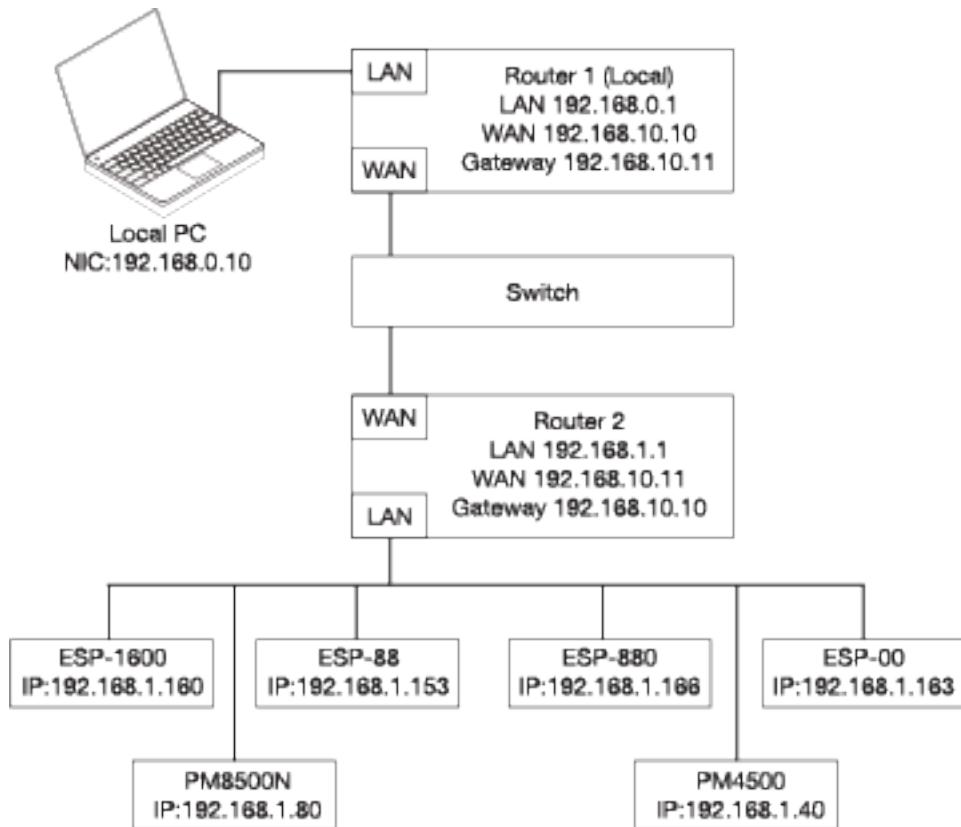
Router to Router connection

In order for CSD to communicate with remote devices, you need to follow particular steps before you can scan, upload, download, etc.

In the following example, the local network will be within the 192.168.0.xxx range, while the remote network will be within the 192.168.1.xxx range. The PC with ControlSpace Designer software is within the local range while all ControlSpace hardware is on the same network.

Example Setup:
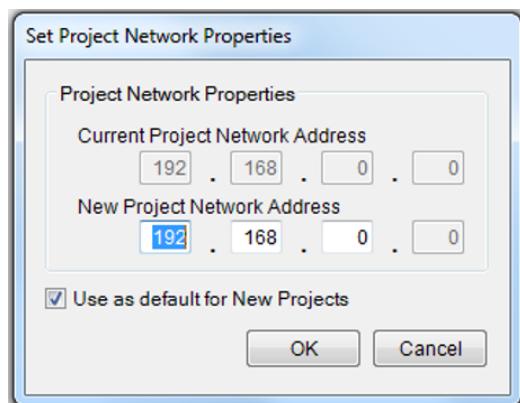
- Laptop PC NIC: IP = 192.168.0.10 /24; Gateway = 192.168.10.11
- Router 1 (Linksys): LAN = 192.168.0.1; WAN = 192.168.10.10
- Switch (D-Link)
- Router 2 (TP-LINK): LAN = 192.168.1.1; WAN = 192.168.10.11
- CSD Project and Devices: IP = 192.168.1.x /24
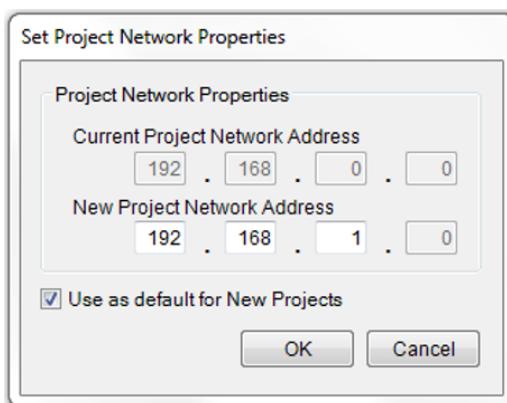
NOTE: You wll not need to change the IP Address of your local NIC.

First, CSD must be set up to communicate with the remote network. If not already set, select **System/Enable Remote Communication**. Upon transitioning between remote mode and local mode, you will be offered the opportunity to save your current design before starting with an empty new design.

Next, select **Tools\Set Project Network Properties**. After the Dialog is open, change the "New Project Network Address" to match the remote network.

  Dialog before change   *Dialog after change*

Close the dialog. CSD will now look to the remote network for devices.

Remote Mode

Project Files can be loaded from a device on the remote network that will be used to communicate with all of the devices on that network. To do this, there must be at least one ControlSpace device on the remote network with a known IP Address. CSD will not be able to communicate with remote devices without this. To see all devices on the remote network, there must be at least one ControlSpace device (typically the RTC/Main device) that has been loaded with a Project File containing those other devices.

When in Remote Mode, the remote connection icon appears in the toolbar.
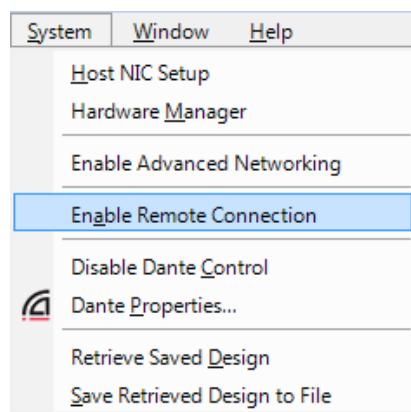

Toolbar When Not in Remote Mode
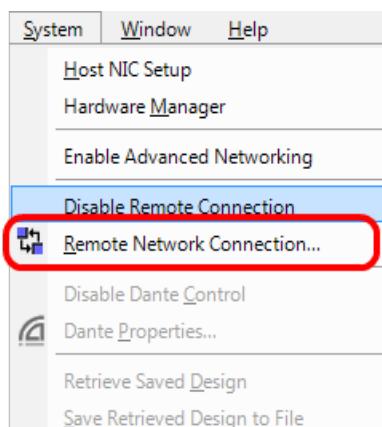
Toolbar When in Remote Mode

Likewise, the System Menu indicates a remote network connection.

 System Menu - Not in Remote Mode   *System Menu - In Remote Mode*
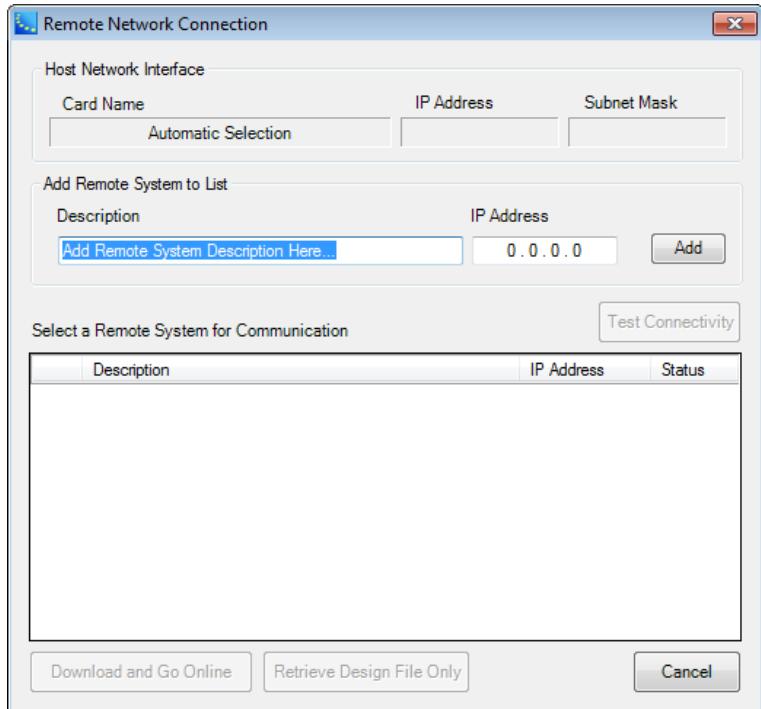
Ideally, one device in the example meets the criteria to communicate with all devices on the remote network - a known IP address and a Project File with all of the remote devices.

Connecting With Remote Devices
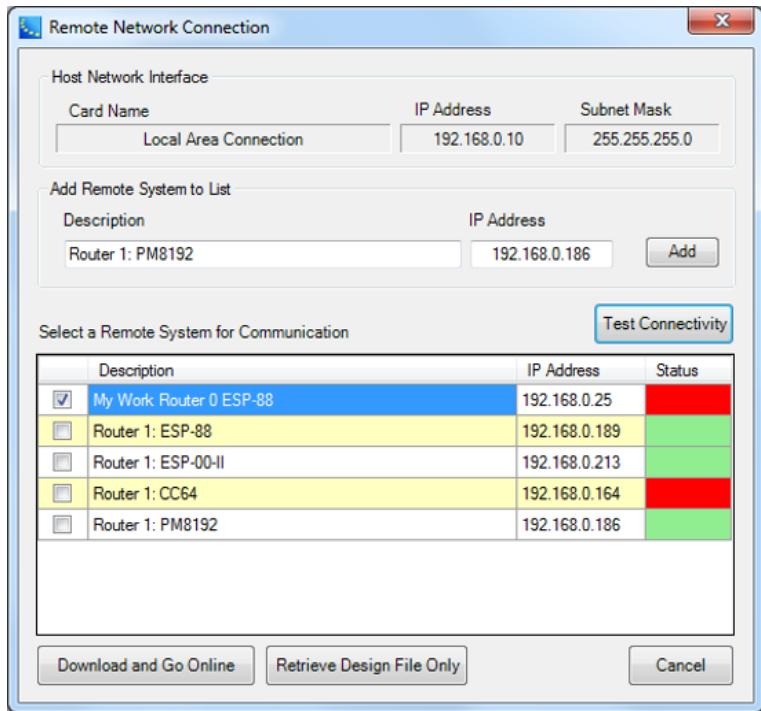
1. After selecting **System/Enable Remote Connection**, click on **Remote Network Connection** to launch the Remote Connection dialog.

2. Enter a description of the remote device to be connected to in the **Description** box.

3. Enter the known IP Address of the device into the **IP Address** box and click **Add**.

   The device is now added to the list of remote devices. Once that device is in the list, you can click **Test Connectivity**. This will show if there is a valid point-to-point connection to the remote device. If the **Status** box is Green, there is a valid connection. If it is Red, the connection is invalid. Note that an item can be removed from the list by selecting the right-click context menu **Remove** option.

   This dialog can be used to easily communicate with any number of installed systems by entering the system name in the description box and/or the IP address of any device in the system.

Once a valid connection is made, CSD can communicate with the device(s).

Clicking **Retrieve Design File Only** is equivalent to clicking **Scan** on a local network. Check the box to the left of the desired device. All of the devices that are contained in the Project file of the checked device will load into Project View. If the devices are physically present on the remote network, they will be shown as such in Project View. If they are not, they will be shown as offline (Grey). Once this is done, normal Upload/Download and other online operations can be performed as they would with local devices.
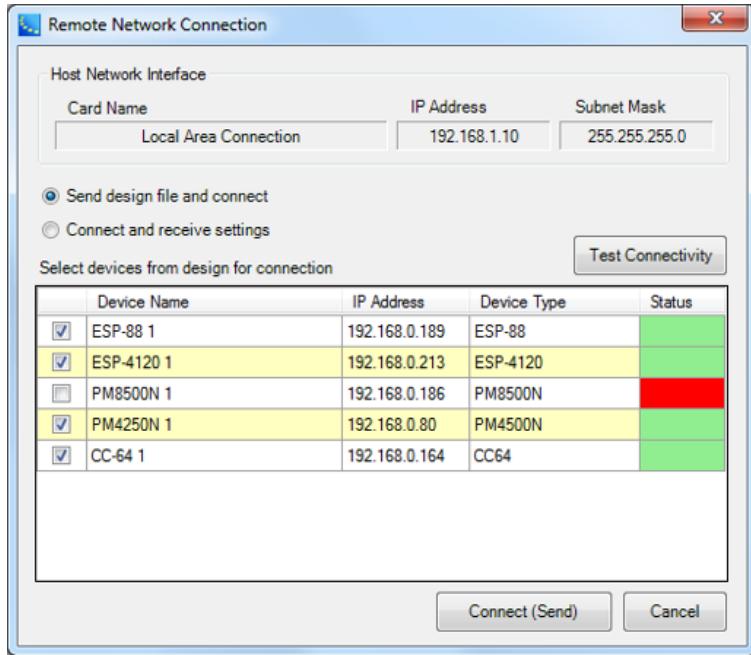
Clicking **Download and Go Online** will Download all Project Data of the devices loaded into the checked device. This essentially skips the **Retrieve Design File Only** step above. CSD will connect to the checked device, and download the Program File from the device. If any devices are not online, they will be shown with Grey headers.

You can now add devices to the Remote Network Connection Device List and recall Remote systems at will.

Remote Network Connection with Design File
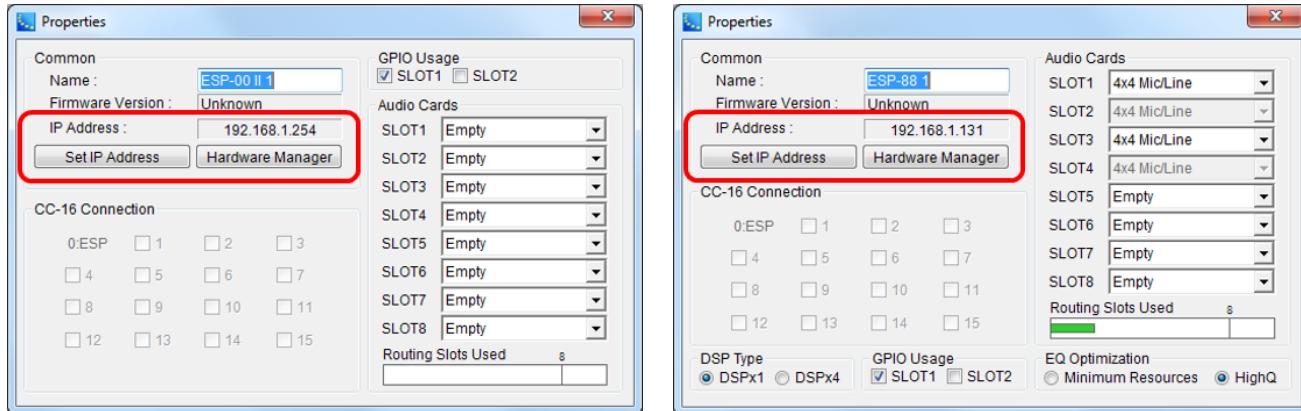
If you have a design file for your system, you can send it to selected devices and establish a connection.
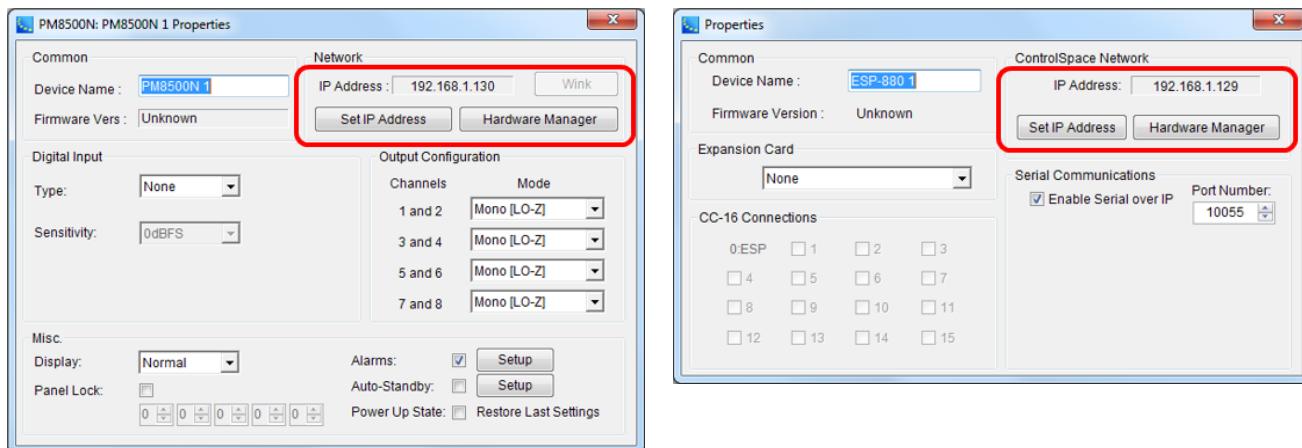
Select devices from the list and click **Connect (Send)**. A connection will be made and the Remote Network Connection dialog will change to reflect data in the design file.
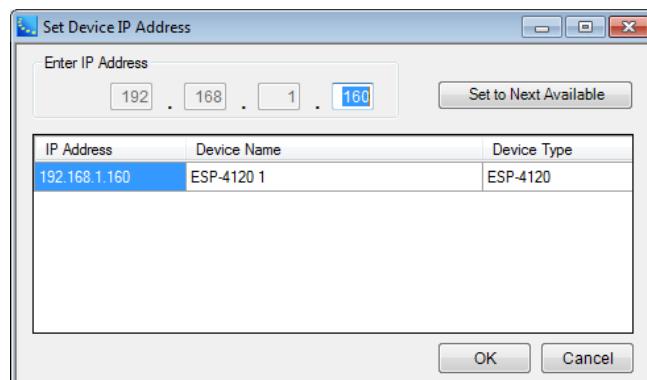
Setting Device IP Addresses

When changing the project network address, the IP addresses, gateway and subnet mask addresses of all devices in the project will be modified to be consistent with the new project settings. To change the IP of a project networked device, including ESP-00, ESP-88, PM, CC64 and CobraNet cards, launch the device properties dialog and click the **Set IP Address** button. For convenience, these dialogs also have a link to the Hardware Manager.
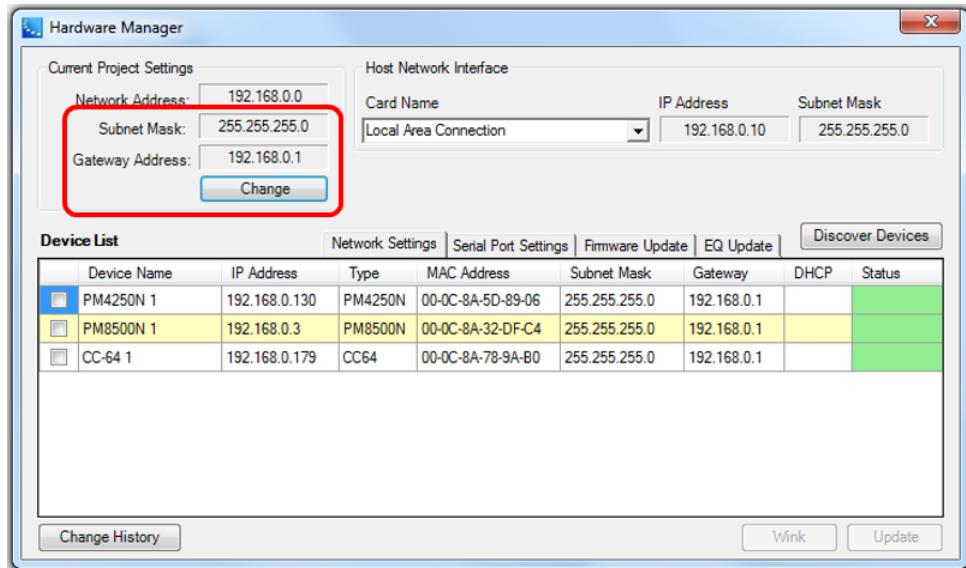
After clicking the **Set IP Address** button, the **Set Device IP Address** dialog is displayed. For convenience, the project properties are displayed across the upper portion, including the range of IP addresses that lie within the project subnet range. The project subnet mask dictates which octets within the IP address that can change and still fall within the target range. However, unless the mask is the default \24, or the newly supported \16, there will be some addresses that can be entered that are not allowed. In that case a warning will be issued, and the original IP address restored.


NOTE: Dante is not supported remotely. When in Remote Mode, right-clicking on a device or Dante card will offer the option to display the Dante properties as queried by the host device, but will not launch Dante communication.
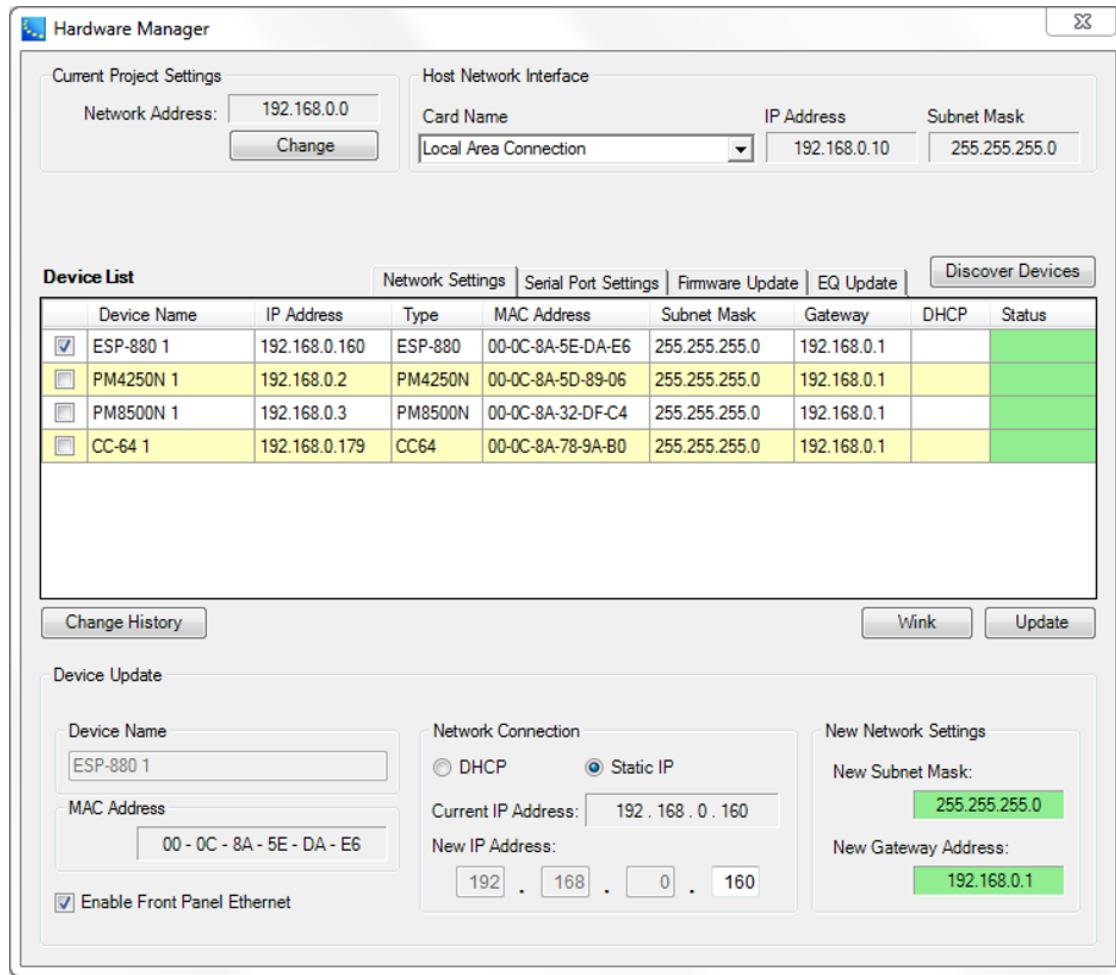
Variable Subnets

To use the variable subnet feature, select the **System/Enable Advanced Networking** menu item before launching the Hardware Manager. Now, when you launch the Hardware Manager, the mask and gateway properties of the networked devices are shown, and you are allowed to set these properties. The Hardware Manager is used to transition devices from the default network /24 to a different size subnet. ControlSpace® Designer™ supports only a single subnet at a time.
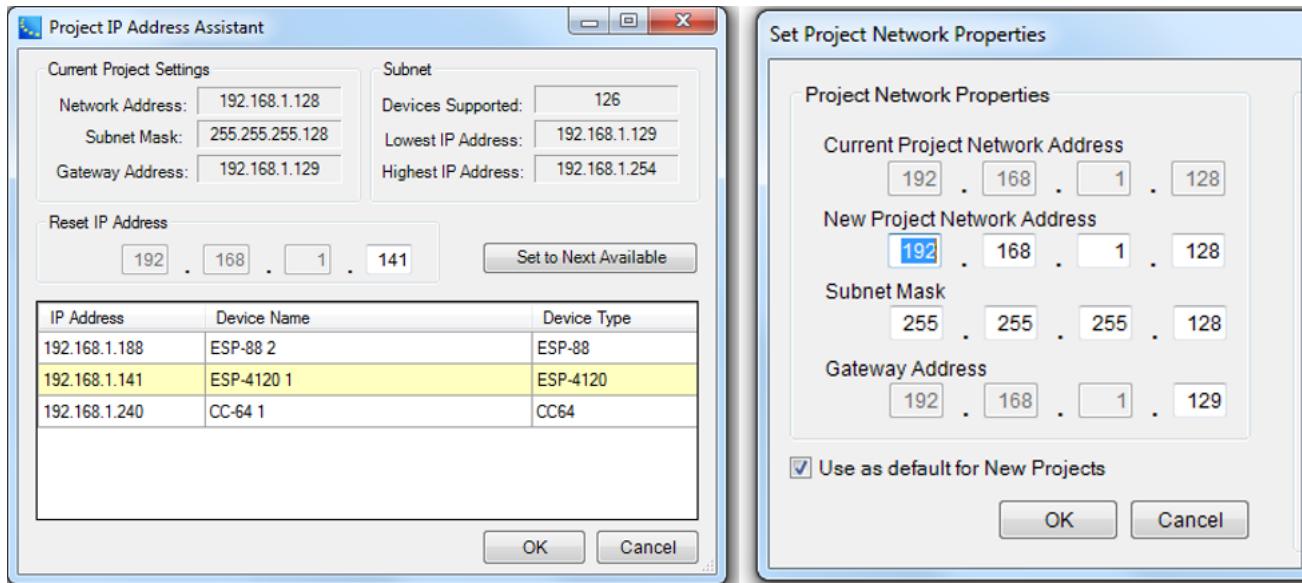
Hardware Manager after enabling advanced networking

Once devices are discovered, and the Device List is populated, you can change the project network properties to the target address and subnet size. Once set, the devices are selected one by one, and the new properties can then be uploaded to those devices. The properties include the IP address, the Subnet Mask address, the Gateway address, and other device type specific information. If a single device is selected, the lower device area now displays the new network settings, that is, the values sent to the device upon update. The color coding indicates if a change will take place.

Hardware Manager populated with devices

Once changed, the devices will not appear in the list on Discover Devices unless the Host NIC is set properly to reach the modified devices and the project network is reset to the target address.
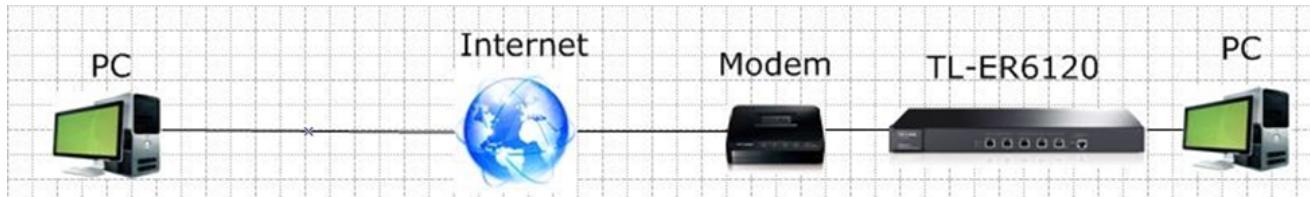
NOTE: Only later versions of Firmware support setting the Subnet Mask address and the Gateway address. However, if the version of Firmware for the updating device is too old, a warning is displayed to that effect. The IP Address can still be updated, but is not recommended. It would be better to update the firmware first before changing subnets.

Using VPN

A Point-to-Point Tunneling Protocol (PPTP) Server is used to create a VPN connection for remote clients. The following instructions show you how to configure a PPTP Server on a TP-Link router. These steps may vary based on the VPN router you choose to use.

TP-LINK is a registered trademark of TP-LINK TECHNOLOGIES CO., LTD..

Typical VPN Tunnel Diagram

Four main tasks comprise creating a VPN connection:

Make sure PCs on both sides can access the Internet

Configure a PPTP Server on VPN router

Configure a PPTP client on the remote PC (Windows 7)

Configure ControlSpace® Designer™ Software

For an example, see "VPN Site-to-Site Example" on page 43.

Make sure PCs on both sides can access the Internet

Before setting up a VPN tunnel, you need to ensure that the PCs on both sides are connected to the Internet. Once that is established, use the following steps to properly configure the VPN settings on each side.

NOTE: If the Router is behind a Network Address Translation (NAT) device, Virtual Server or DMZ, they should be configured on the NAT device. Otherwise, the VPN tunnel can't be established.

Configuring a PPTP Server on a TP-LINK router

Step 1:

Access the management web page for the router. The default address of the TP-LINK router is 192.168.0.1. Enter the default username and password for the router.

TP-Link Login

From the System Status page, write down the IP Address <WAN IP Address> and LAN IP address range.

TP-Link System Status Page

Step 2:

Select **VPN>L2TP/PPTP>IP Address Pool**. Enter the Pool Name, IP Address Range, and then click **Add**.

NOTE: The IP Address pool must be a different range than the LAN IP address range.

Step 3:

Select **L2TP/PPTP Tunnel**. Configure the following settings:

- Protocol: PPTP
- Mode: Server
- Account Name: <account name>
- Password: <password>
- Tunnel: Client-to-LAN
- Max Connections: 1-10 (We used 5 in this example)
- Encryption: Enable
- IP Address Pool: Select the group added in Step 2.
- Status: Activate

Click **Add**.

Click **Save**.

Configuring the L2TP/PPTP Tunnel

Configuring a PPTP client on remote PC (Windows 7)
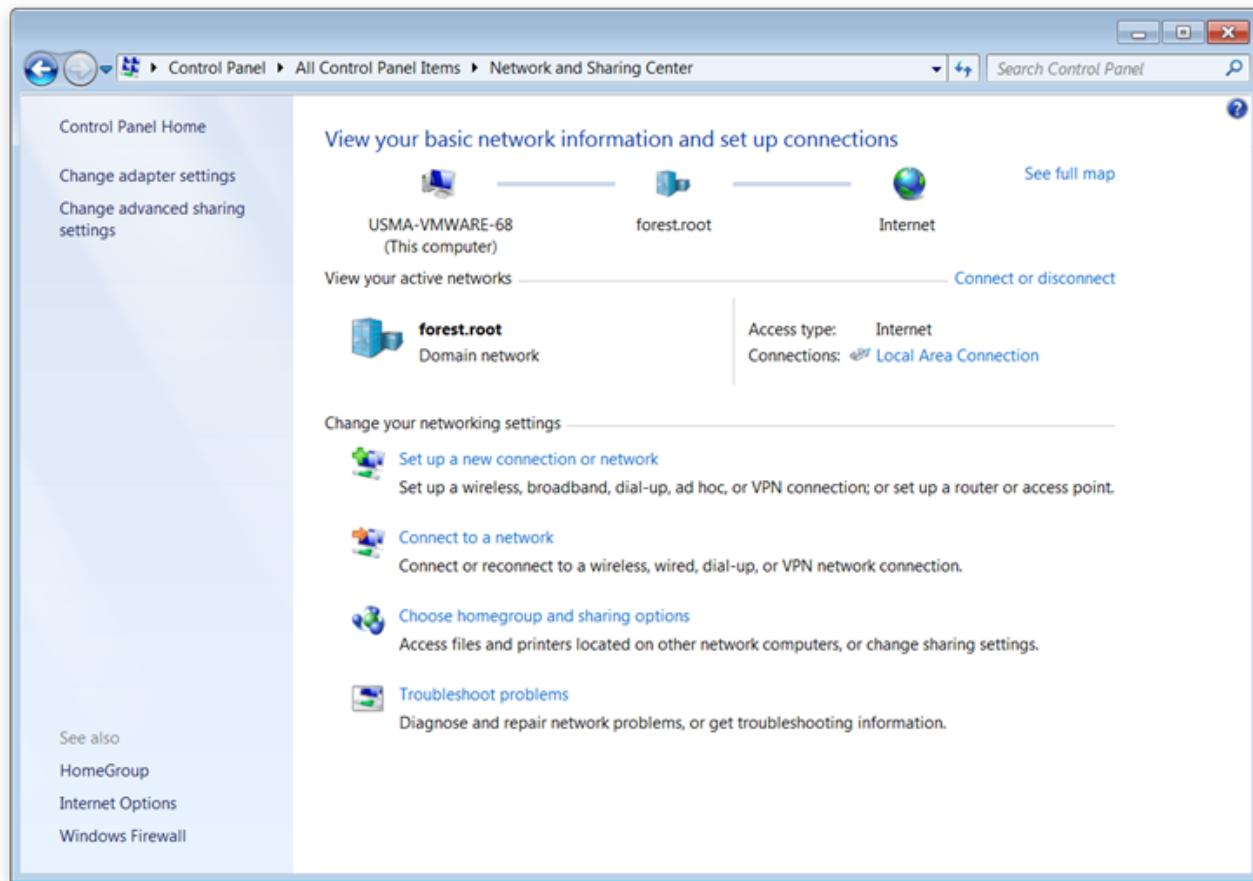
NOTE: Fora remote PC to connect to a PPTP server, it can use the Windows built-in PPTP software or a third-party PPTP software.

Step 1:

Select **Start>Control Panel>Network and Internet>Network and Sharing Center**.

Step2:
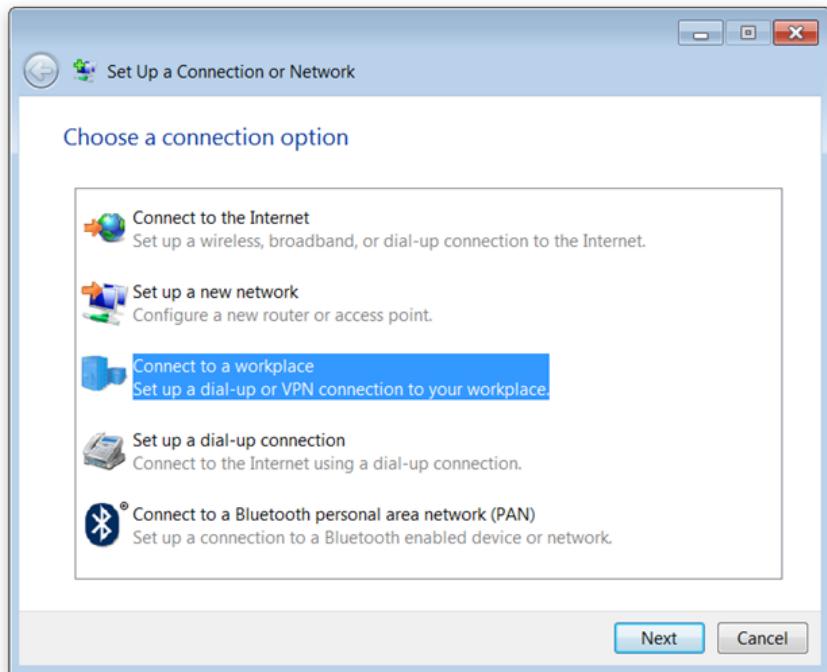
Click **Set up a new connection or network**.

Windows Network and Sharing Center

Step 3:
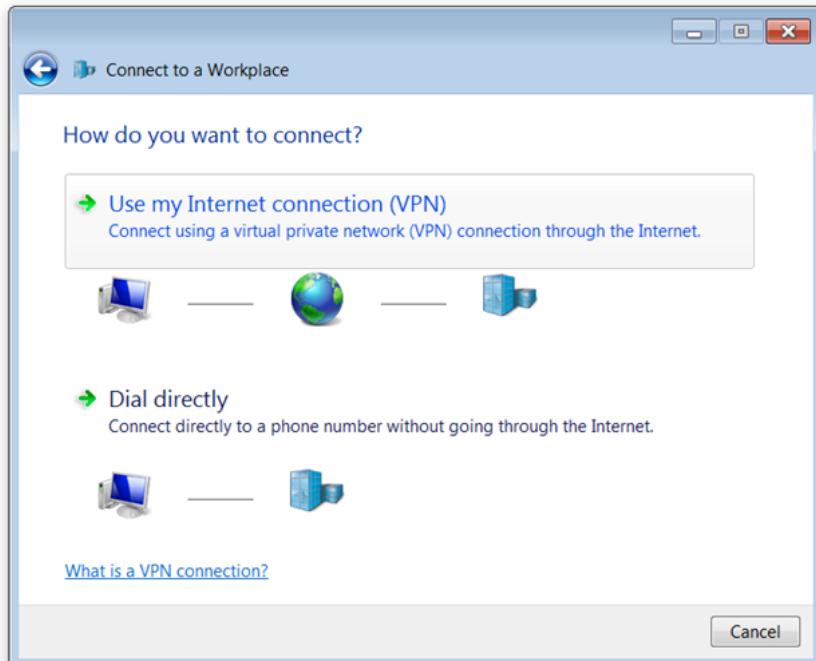
Choose **Connect to a workplace**, and click **Next**.

Choosing a Connection Option

Step 4:

Select **Use my Internet connection (VPN)**.
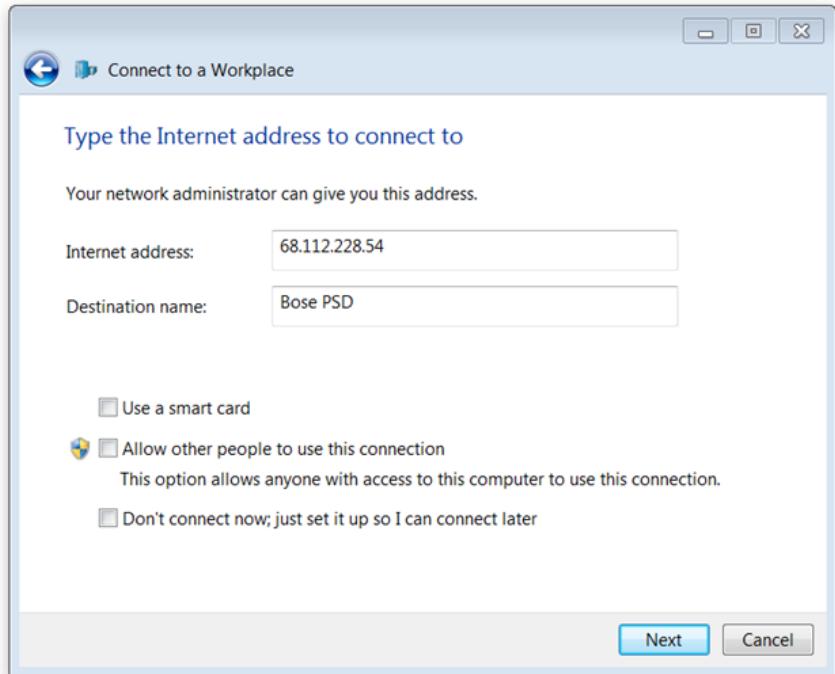
Choosing a Type of Connection

Step 5:

Enter the following information:
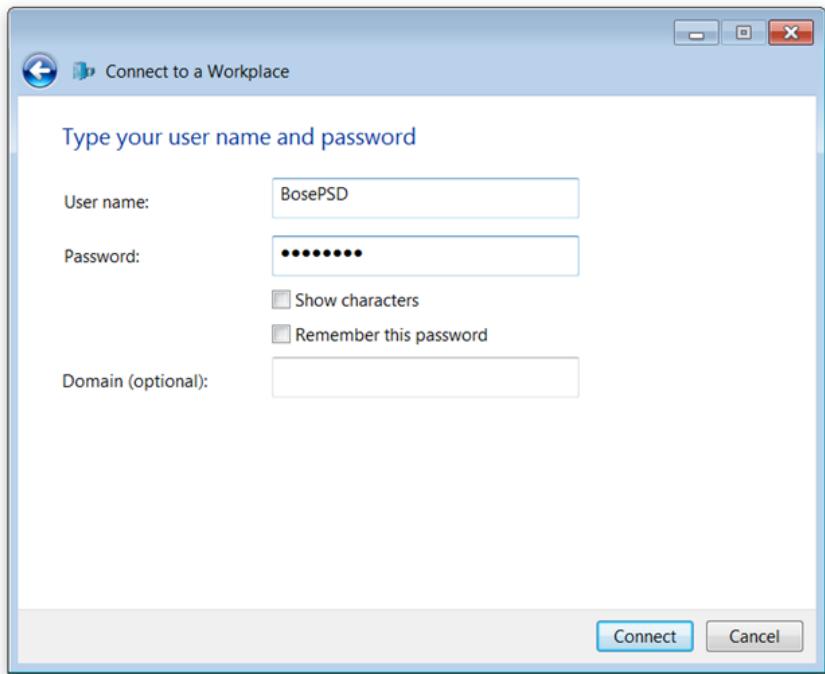
- Internet Address: <WAN IP Address> (See Step 1 - Configuring a PPTP Server on TP-LINK router)
- Destination Name: <Name of Site>

Entering the Internet Address and Destination
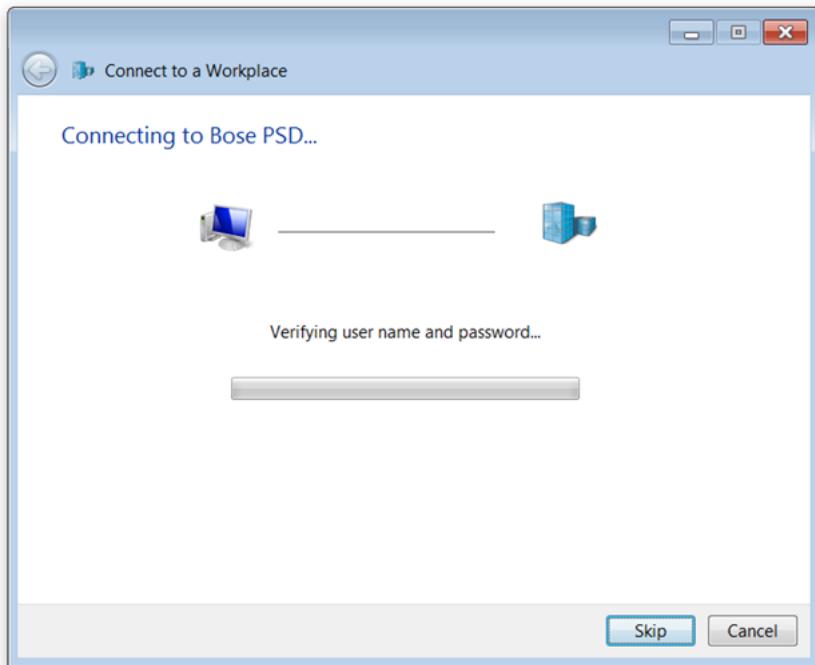
Step 6:

Enter User name and Password and click **Connect**.
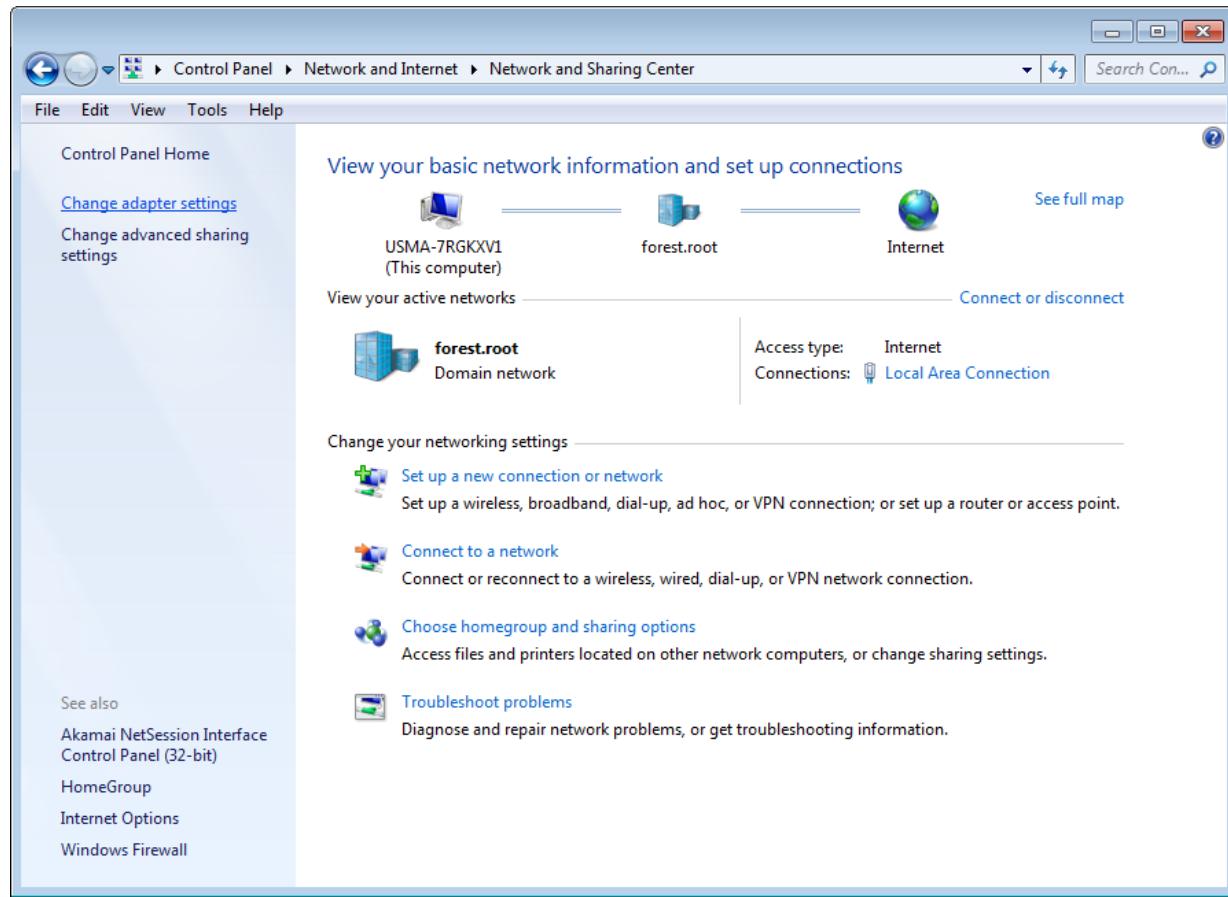
Step 7:

The VPN Connection is created and should now connect to the remote system
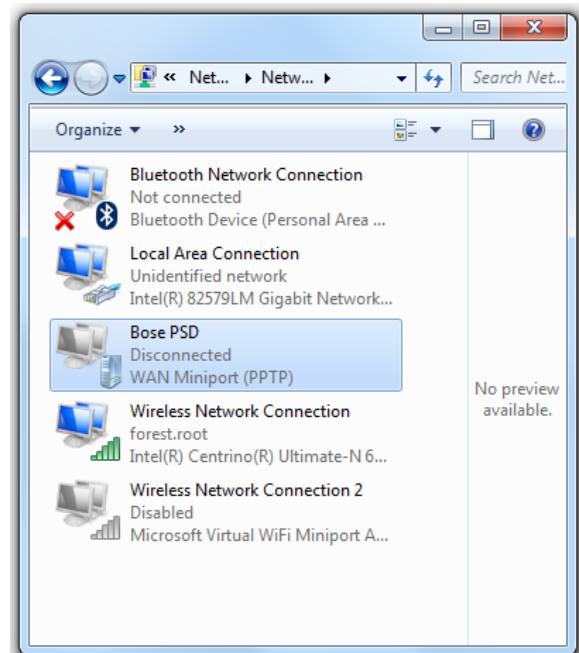
Step 8:

Go to **Network and Sharing Center>Change adapter settings**.

Step 9:

Double-click on **Bose PSD** to open the login panel.

Selecting Bose PSD VPN

Step 10:

Enter User name and Password and then click **Connect**.
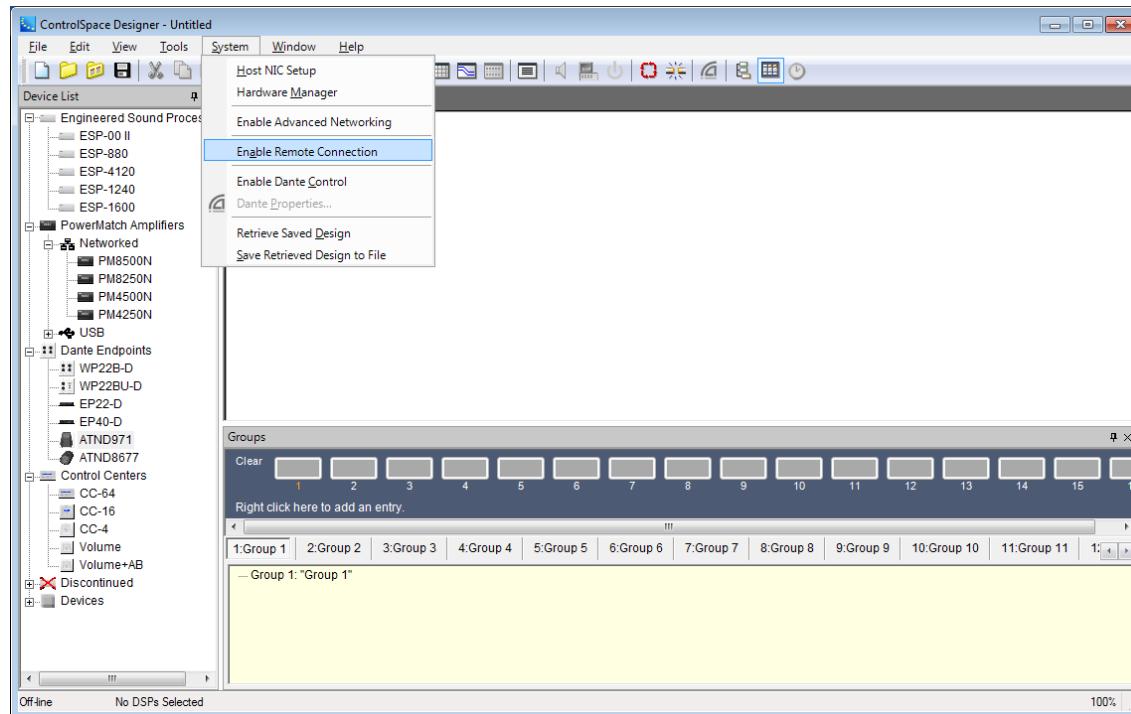
Connecting to VPN

Configure ControlSpace Designer Software

Step 1:
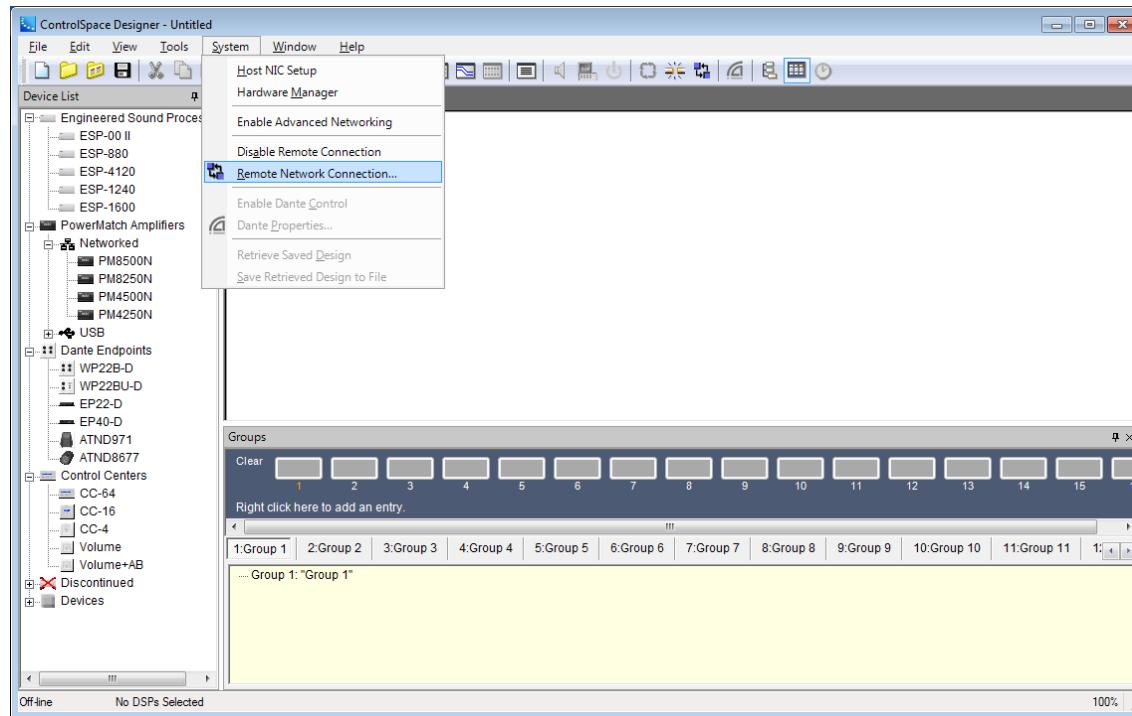
Navigate to **System>Enable Remote Connection**.

Enabling a Remote Connection

Step 2:

Navigate to **System>Remote Network Connection**.
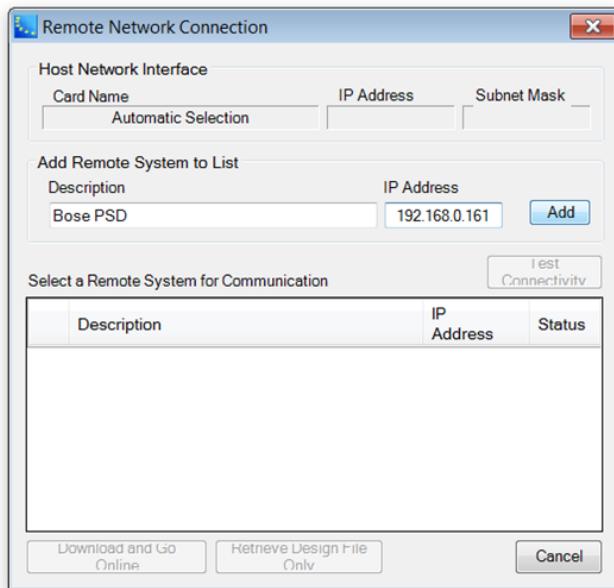
Step 3:

Enter the following Information:

- Description: <Description of Site>
- IP Address: <IP Address of ESP/PM that contains the CSD file>
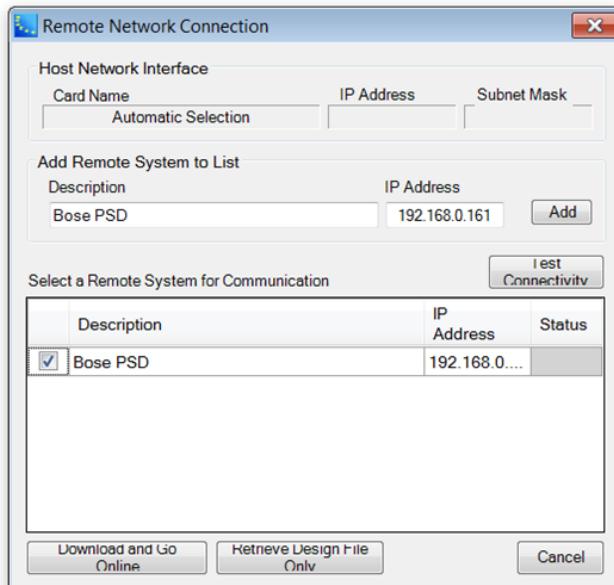
Click **Add**.

Adding Remote Connection Information

Step 4:
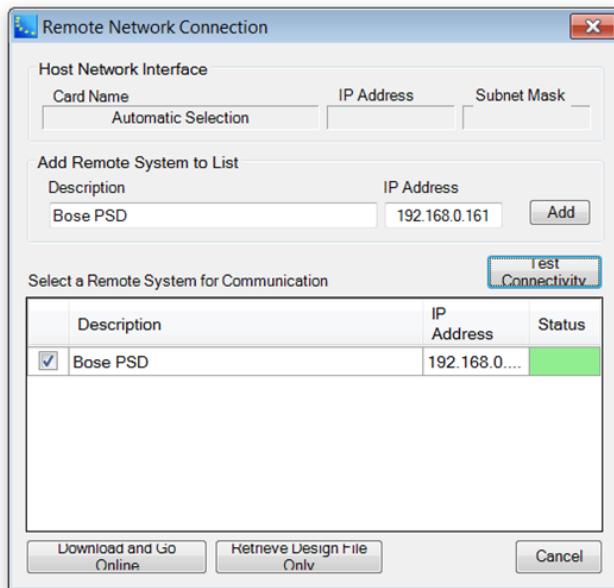
Click the check box next to the remote system **Description** name, and then click **Test Connectivity**.

Starting Connectivity Test

Step 5:

Verify the settings. If the everything is setup properly the Status indicator will be Green.

Connectivity Test Results

Step 6:

Click **Download and Go Online** or **Retrieve Design File Only** based on what you want to do.

Now you can use ControlSpace Designer like you are connected locally.

VPN Site-to-Site Example
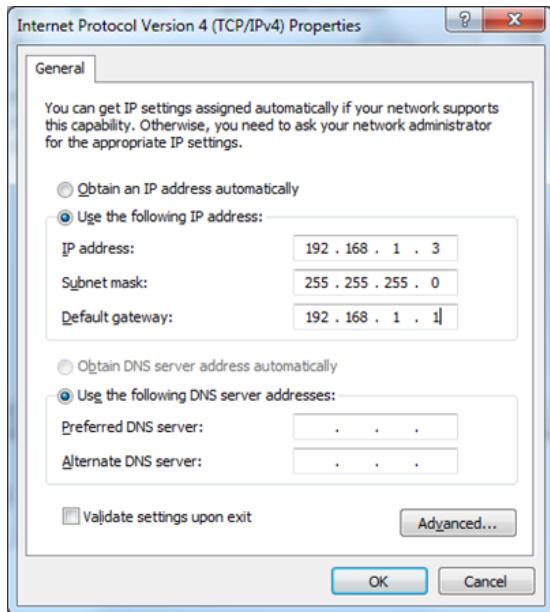
This VPN Site to Site example describes how to configure the following hardware:

- Two NETGEAR® FVS318G ProSAFE® VPN Firewall Routers
- One NETGEAR ProSAFE Switch
- At least two ControlSpace® networkable devices (PowerMatch® amplifier, ESP processor, CC-64 controller)
- Two PCs

NETGEAR, the NETGEAR logo, and ProSAFE are trademarks of NETGEAR, Inc. Any other trademarks in this document are for reference purposes only.©2015 NETGEAR, Inc.
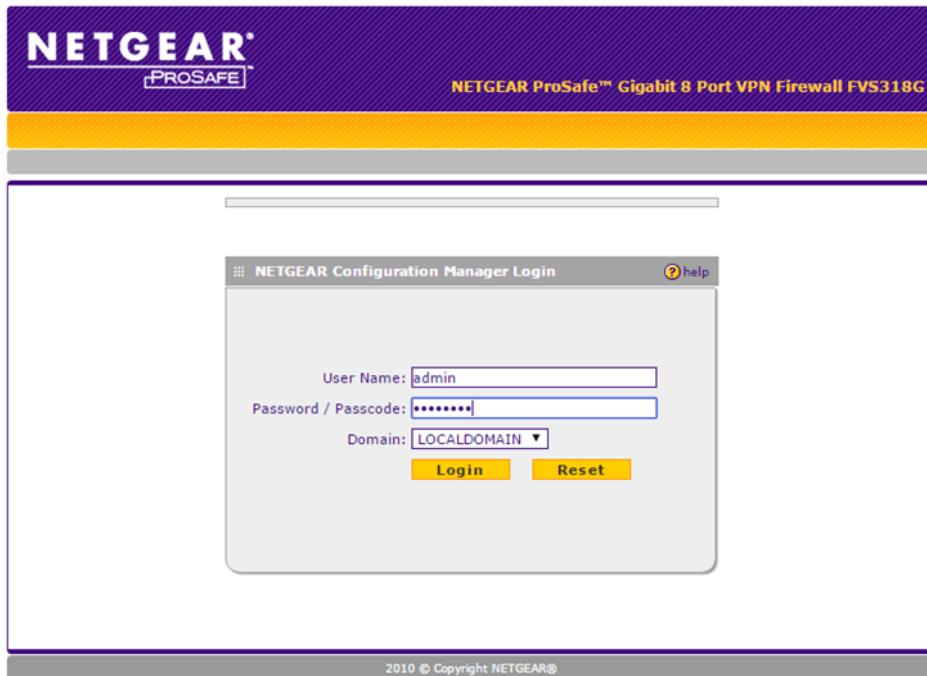
Configure Router 1

1. Connect a PC to Router 1. Set the PC IP address to the 192.168.1.n scheme.

PC Properties for Router 1

2. Launch the Web Browser and enter IP of Router 1 (192.168.1.1 in this example).

NETGEAR Login for Router 1

3. Enter User Name: admin and Password: <password to log in>.

4. In the router, select the VPN Wizard.

VPN Wizard for Router 1

A. Set VPN tunnel to connect to the following peers: Gateway.

B. Enter a connection name and Remote IP Type pre-shared key of your choosing.

C. Enter End Point Information:

Remote WAN IP Address: 192.168.10.11

Local WAN IP Address: 192.168.10.10

D. Enter Secure Connection Remote Accessibility Information:

Remote LAN IP Address: 192.168.0.1

Remote LAN Subnet Mask: 255.255.255.0

E. Click **Apply**.
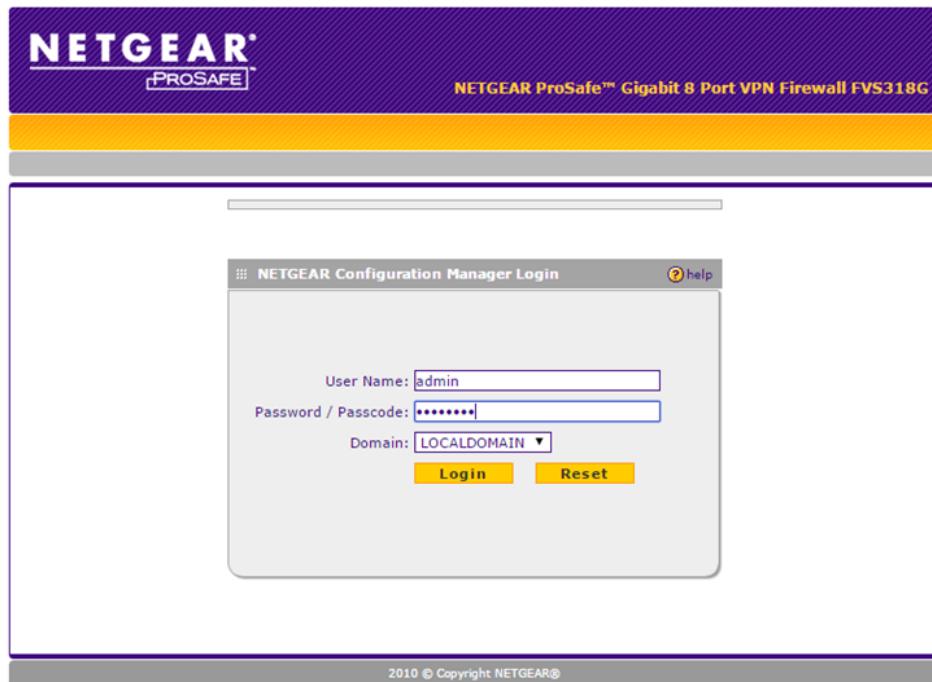
Configure Router 2

1. Connect a PC to Router 2. Set the PC IP address to the 192.168.0.n scheme.

PC Properties for Router 2

2. Launch Web Browser and enter IP of Router 1 (192.168.0.1 in this example).

3. Enter User Name: admin and Password: <password to log in>.

NETGEAR Login for Router 2

4. In the router select VPN Wizard

VPN Wizard for Router 2

A. Set VPN tunnel to connect to the following peers: Gateway.

B. Enter a connection name and Remote IP Type pre-shared key of your choosing.

C. Enter End Point Information:

Remote WAN IP Address: 192.168.10.10

Local WAN IP Address: 192.168.10.11

D. Enter Secure Connection Remote Accessibility Information:

Remote LAN IP Address: 192.168.1.1

Remote LAN Subnet Mask: 255.255.255.0

E. Click **Apply**.

Connect WAN ports of Router 1 and 2 to the NETGEAR switch to simulate WAN

Connect ControlSpace Device(s) to each Router which is pre-configured with IP addresses that correspond to each Router.

For example:

- The devices on Router 1 will follow the 192.168.1.n IP scheme
- The devices on Router 2 will follow the 192.168.0.n IP scheme

Confirm that the PC on Router 1 can communicate with devices on Router 2

1. Reconnect PC to Router 1, Set PC NIC IPv4 to 192.168.1.1 / 255.255.255.0.

2. Log into Router 1 192.168.1.1:

    A. Select VPN.

    B. Select Connection Status.

    C. Click **Connect**. Confirm that the connection is established.

3. While connected to Router 1, perform the following ping tests via Windows command console: (Turn off PC's Wi-Fi NIC).

    A. Enter ping followed by the corresponding IP address of the LAN, WAN, and Gateway IP for each Router, for example:

        C:\>ping 192.168.10.11 (Remote WAN)

        Pinging 192.168.10.11 with 32 bytes of data:
        Reply from 192.168.10.11: bytes=32 time=5ms TTL=63
        Reply from 192.168.10.11: bytes=32 time=4ms TTL=63
        Reply from 192.168.10.11: bytes=32 time=4ms TTL=63
        Reply from 192.168.10.11: bytes=32 time=4ms TTL=63
        Ping statistics for 192.168.10.11:
            Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
        Approximate round trip times in milli-seconds:
            Minimum = 4ms, Maximum = 5ms, Average = 4ms

        C:\>ping 192.168.10.10 (Local WAN)

        Pinging 192.168.10.10 with 32 bytes of data:
        Reply from 192.168.10.10: bytes=32 time=1ms TTL=64
        Reply from 192.168.10.10: bytes=32 time=1ms TTL=64
        Reply from 192.168.10.10: bytes=32 time=1ms TTL=64
        Reply from 192.168.10.10: bytes=32 time=1ms TTL=64
        Ping statistics for 192.168.10.10:
            Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
        Approximate round trip times in milli-seconds:
            Minimum = 1ms, Maximum = 1ms, Average = 1ms

        C:\>ping 192.168.1.1 (Local LAN – Router 1 Gateway)

Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=2ms TTL=64
Reply from 192.168.1.1: bytes=32 time=2ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Ping statistics for 192.168.1.1
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>ping 192.168.0.1 (Remote LAN – Router 2 Gateway)

Pinging 192.168.0.1 with 32 bytes of data:
Reply from 192.168.0.1: bytes=32 time=8ms TTL=63
Reply from 192.168.0.1: bytes=32 time=7ms TTL=63
Reply from 192.168.0.1: bytes=32 time=7ms TTL=63
Reply from 192.168.0.1: bytes=32 time=7ms TTL=63
Ping statistics for 192.168.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 7ms, Maximum = 8ms, Average = 7ms

B. Enter ping followed by the corresponding IP address of the ControlSpace devices connected to Router 2

C:\>ping 192.168.0.161 (CS device attached to Router 2)

Pinging 192.168.0.161 with 32 bytes of data:
Reply from 192.168.0.161: bytes=32 time=9ms TTL=62
Reply from 192.168.0.161: bytes=32 time=8ms TTL=62
Reply from 192.168.0.161: bytes=32 time=8ms TTL=62
Reply from 192.168.0.161: bytes=32 time=8ms TTL=62
Ping statistics for 192.168.0.161:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 8ms, Maximum = 9ms, Average = 8ms

C:\>ping 192.168.1.168 (CS device attached to Router 1)

Pinging 192.168.1.168 with 32 bytes of data:

Reply from 192.168.1.168: bytes=32 time=1ms TTL=64

Reply from 192.168.1.168: bytes=32 time=1ms TTL=64

Reply from 192.168.1.168: bytes=32 time=1ms TTL=64

Reply from 192.168.1.168: bytes=32 time=1ms TTL=64

Ping statistics for 192.168.1.168:

   Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

   Minimum = 1ms, Maximum = 1ms, Average = 1ms

D. Launch CSD while connected to Router 1, scan for devices attached to Router 1 (192.168.1.n). All CS devices connected to Router 1 should populate Project View.

E. Within CSD, select New to clear Project View. Change the Project Network Address to 192.168.0.n and scan for CS Devices on Router 2. All CS devices connected to Router 2 should populate Project View.

Connecting to the system

Once the system is configured for operation on the ControlSpace® Network you can connect to the system, upload a configuration, and control the system's operation. ControlSpace® Designer™ offers the option of either sending the current configuration to the hardware, or retrieving the stored configuration from the hardware when connecting to the system.

The system connection process used is based on the current state of the Project View at the start of the connection process: Empty Project View, Project View populated from a network Scan, or Project View populated with devices from a ControlSpace Project File (.csp). Each of these scenarios is outlined below.
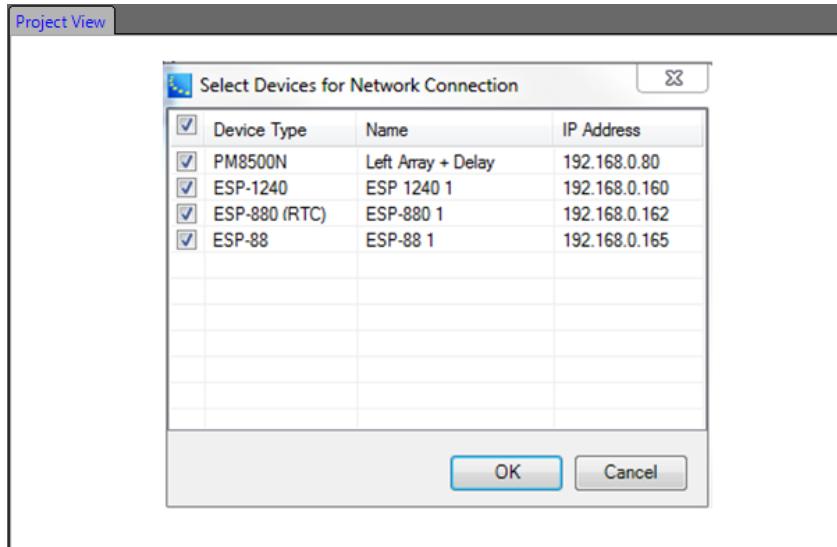
Empty Project View

An immediate connection to the system is initiated using the **Go Online** tool in the main toolbar, or by selecting **Tools>Go Online**. In this situation no devices are present within the Project View tab.

1. Click the **Go Online** tool in the main toolbar to initiate a connection.

If the Project View does not contain any devices you will be asked to select the device which contains the Project File:

NOTE: The Project File contains information related to control programming for the system, and the display of the system devices within the Project View.

2. Select the device which contains the Project File and click **OK**. You are now connected to the system.
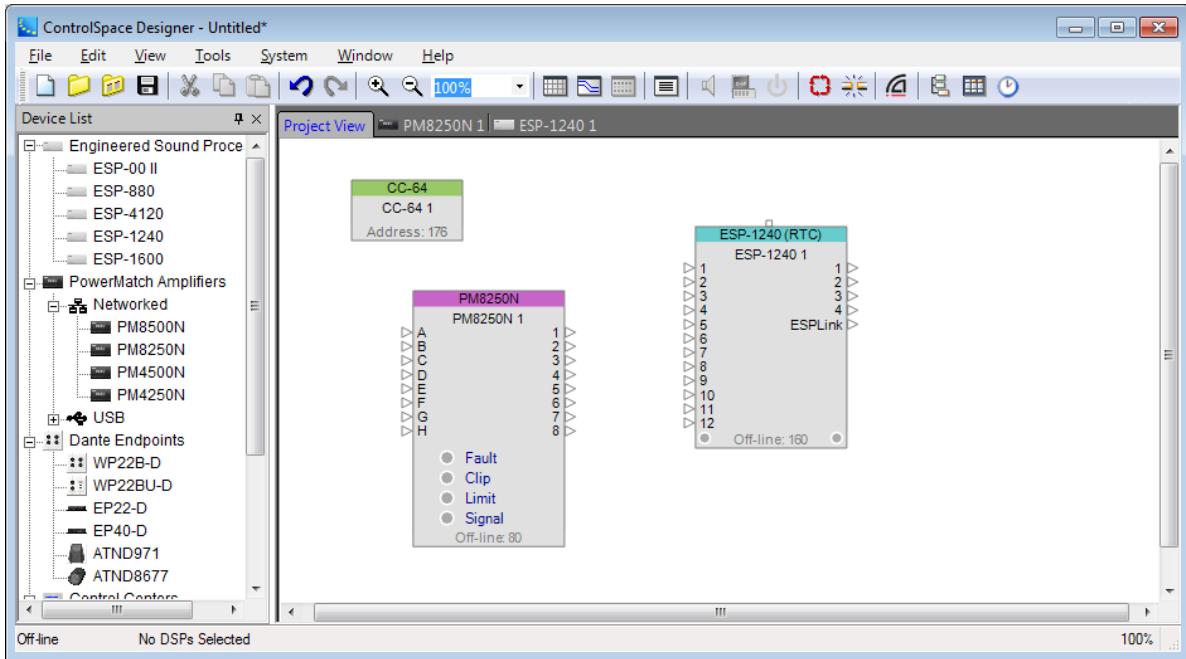
Project View populated from a network scan

In this scenario the Project View contains devices which were added to the view using the network scan function. When a network scan is performed only configuration information is retrieved from the system devices. Any information related to signal processing functionality and settings, and control programming is still resident within the devices, and has not been retrieved for display within ControlSpace Designer software.

To perform a network Scan to identify any active devices on the ControlSpace Network:

1. Click the network **Scan** tool in the main toolbar.
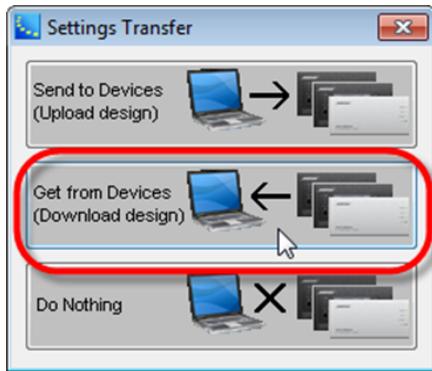
   The Project View is now populated with all the devices currently active on the network:

2. Click the **Go Online** tool in the main toolbar to initiate the connection.
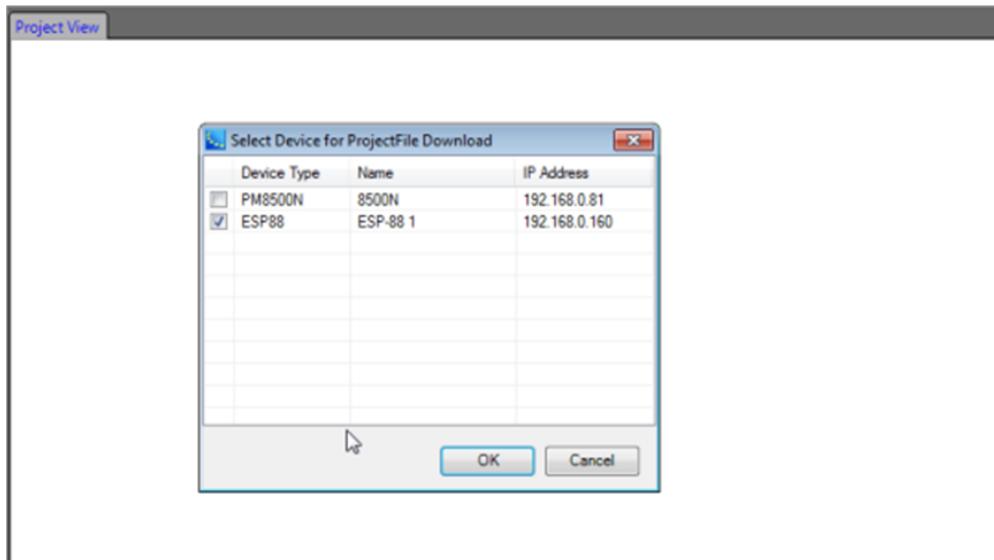
   You will be asked to select which settings you wish to use for this connection session.

3. Select **Get from Devices (download design)**.
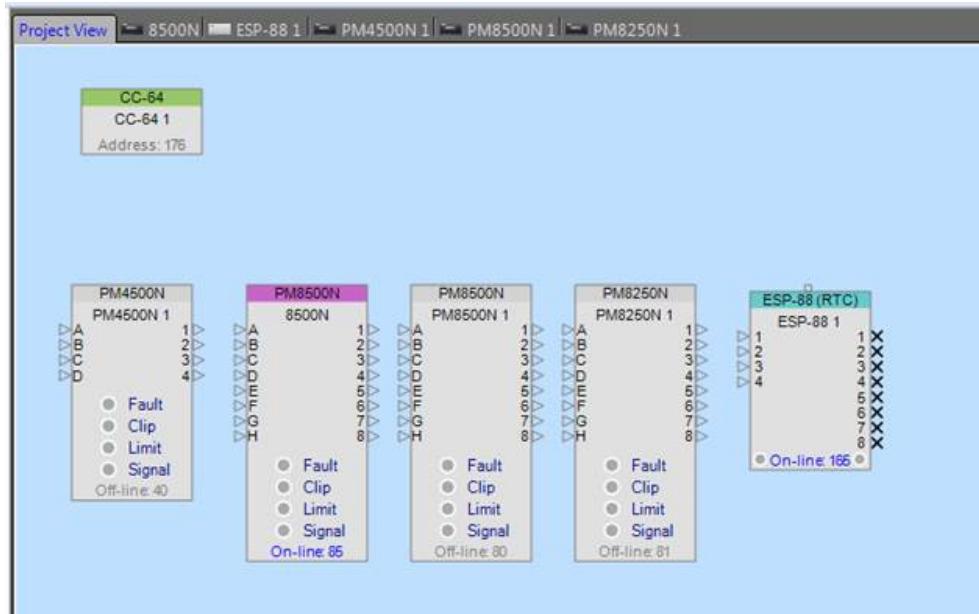
   This will cause the settings within the hardware to be used. If the settings within the Project View were applied, (upload design), it will replace any signal processing and control parameters with the default hardware settings.

4. When asked to save changes to the current document select **No**.

5. Select the device which contains the Project File and select **OK**.

NOTE: The Project File contains information related to control programming for the system, and the display of the system devices within the Project View.

6. You are now connected to the system.

If all system devices contained in the Project File are active on the network, they will all be present and available. If any devices were not active on the network, but present in the Project File they will be indicated as being off-line.
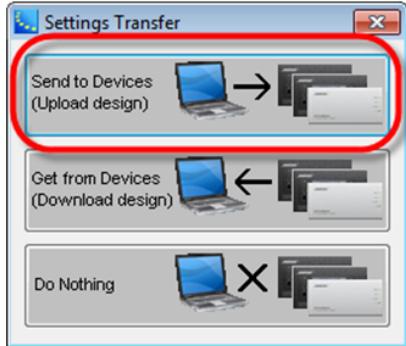
Project View populated with devices from a ControlSpace Project File

This method of connecting to the system is the most common for new system configurations. In this case the Project File has been built to represent the desired system signal processing and control functions which need to be applied to the hardware.
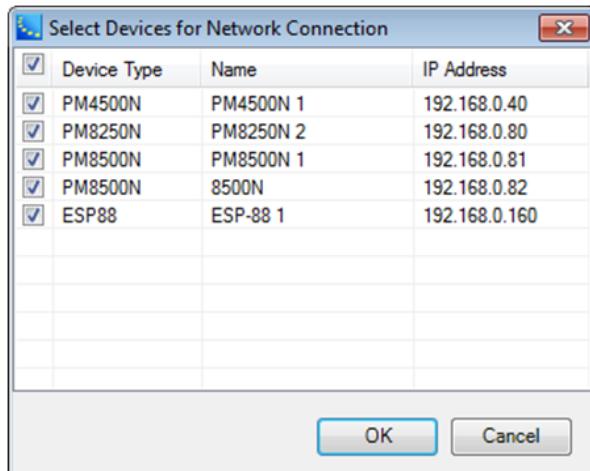
1. Open the desired Project File.

2. Click the **Go Online** tool ⚙ in the main toolbar to initiate the connection.

    You will be asked to select which settings you wish to use for this connection session.

3. Select **Send to Devices (upload design)**.
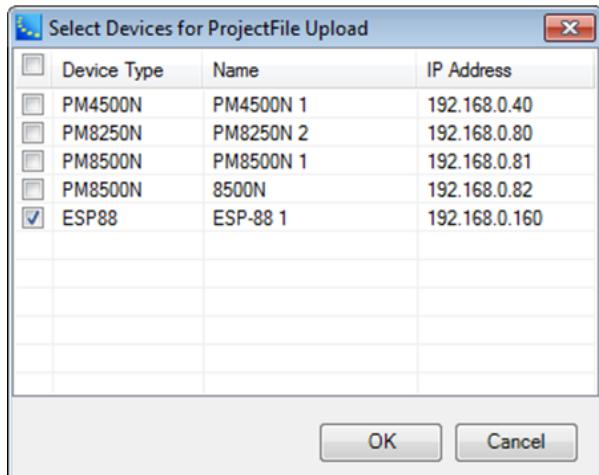
4. Select the devices on the network to which you will connect. In this case, select all devices and click **OK**.
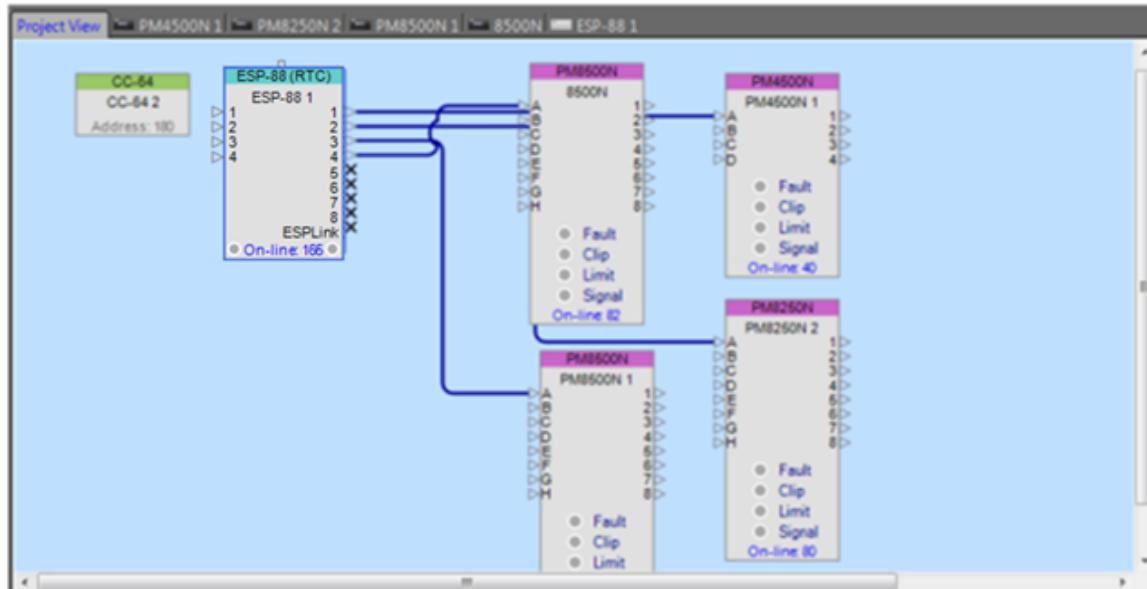
5. Select the devices which will have a copy of the Project File stored within them.

    The Project File contains all device control programming and signal processing information. While it is not necessary to store it in all system devices, it should be stored within the main signal processing unit for future connections.

Select Devices for ProjectFile Upload

	Device Type	Name	IP Address
☐	PM4500N	PM4500N 1	192.168.0.40
☐	PM8250N	PM8250N 2	192.168.0.80
☐	PM8500N	PM8500N 1	192.168.0.81
☐	PM8500N	8500N	192.168.0.82
☑	ESP88	ESP-88 1	192.168.0.160

OK   Cancel
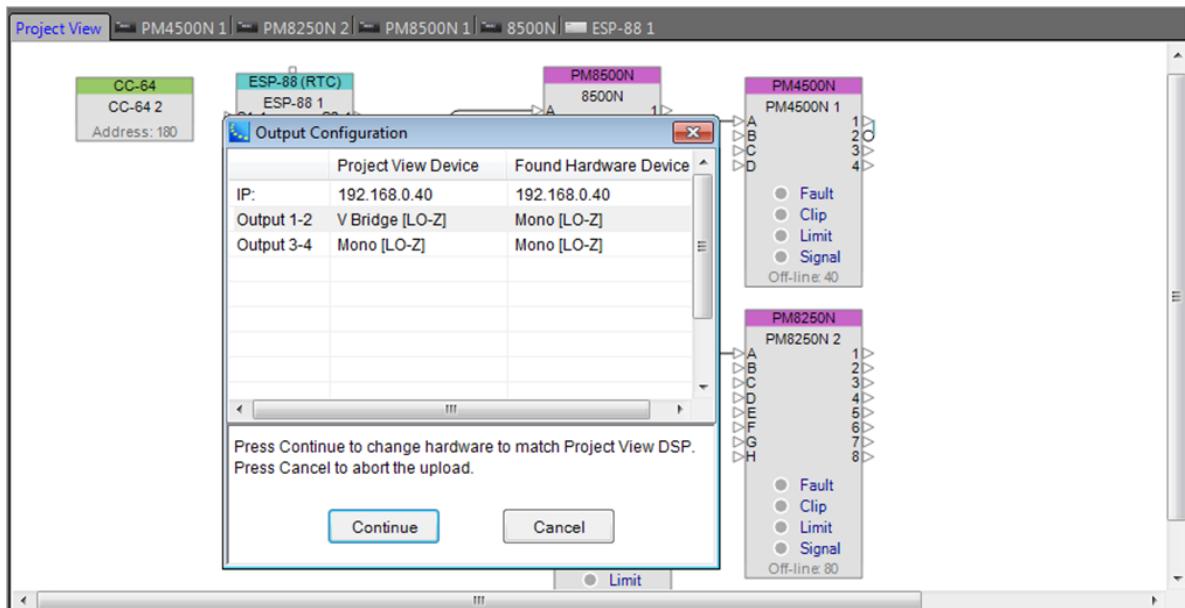
The signal processing and control parameters (Netlist) are transferred to all system devices and the Project File is stored in any selected devices.

You are now connected to the system.

When connecting to a system using a Project File, it is possible to receive a configuration mismatch or device-not-found error:
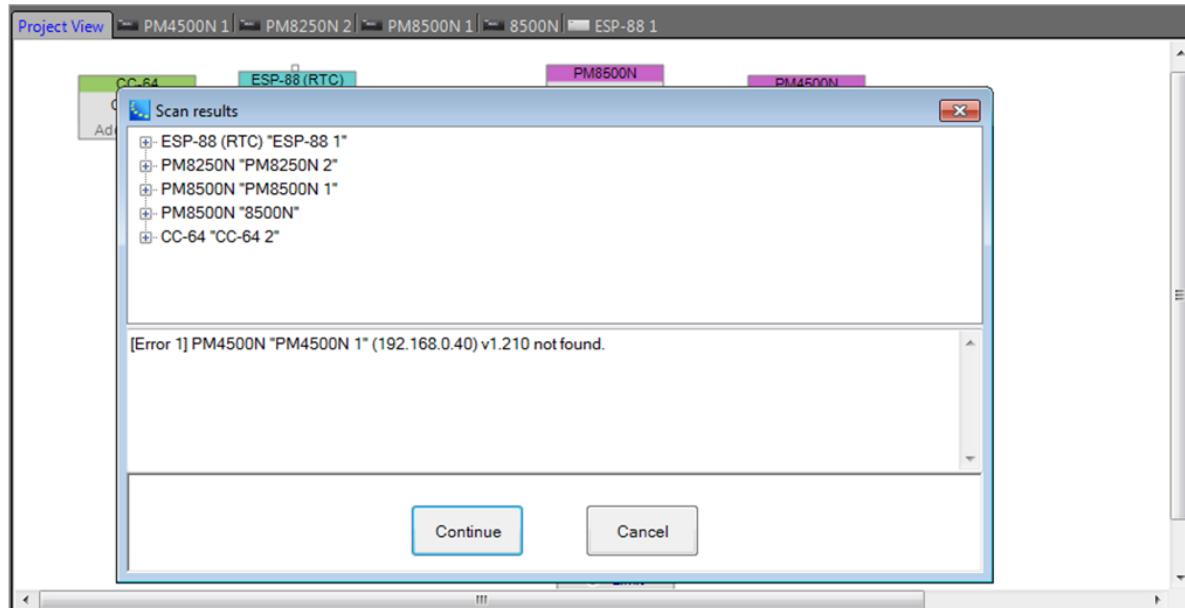
Configuration Mismatch Error: The hardware configuration of the device on the network does not match the configuration of matching device, based upon its IP address, within the design. For example, a PowerMatch amplifier which uses a different output configuration from the one within the design in ControlSpace Designer software. When the device configurations do not match a dialog is presented to describe the differences in the configurations, and to allow you apply the correct configuration to either hardware or to the design.

Connection Error – Configuration Mismatch

Select **Continue** to send the Project View configuration to the hardware, or Cancel to cancel the operation.

Devices Not Found Error: If the project file contains devices that are not active on the network you will receive an error message to notify you of the devices that are present on the network, and the devices in your design which cannot be located.

Scan Error - Devices not found

Select **Continue** to connect to the system, the missing device will appear in the Project View as being off-line. Press **Cancel** to cancel the connection the system.

NOTE: ControlSpace Designer will only establish a connection with those devices that are included in the configuration file. If you do not see a device once the connection is established, it must be added to the configuration file, and the new configuration must be uploaded to the system.

Disconnecting from the system

NOTE: This section applies to networked devices only.

When disconnecting from a networked system you will be prompted to save any changes that were made during the session. Not saving the changes will cause them to be lost during the next power cycle of the system.
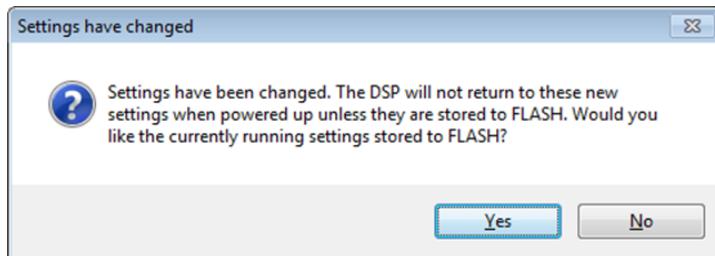
The nature of a ControlSpace® Networked system is that each device on the network powers up to a predefined state. Any changes made to the system during operation are not recalled at the next power-up, unless they expressly saved to system devices using ControlSpace® Designer™ software. When saving the configuration to the hardware you want to make sure that all system settings are in the desired power-on state.

When disconnecting from the system use the following steps:
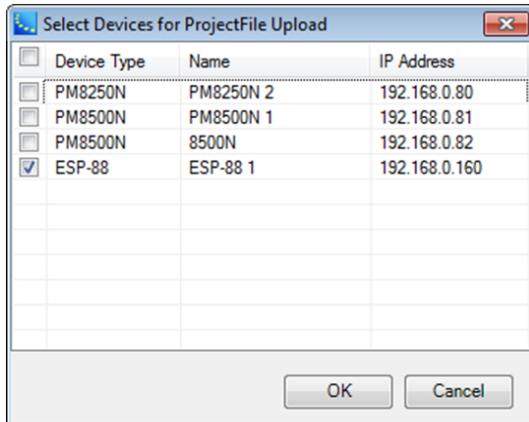
1. Make sure that all system settings are in the desired power-on state for the system.

2. Click the **Go On(Off)line** tool in the main toolbar to initiate the disconnection process.

If no changes were made to system settings during the session you will be immediately disconnected from the system. When a change of any sort to the signal processing settings has been made you will be prompted to save the settings to the system devices:

3. If you wish to make the current settings the new Power-On State select **Yes**. Otherwise you can select **No** and the current settings will not be restored at the next Power On – rather the previously saved configuration will be recalled, and you will immediately go offline from the system.

4. When selecting **Yes** you will be asked in which of the system devices you would like to save the Project File – which contains device signal processing and control information.

Device Type	Name	IP Address
PM8250N	PM8250N 2	192.168.0.80
PM8500N	PM8500N 1	192.168.0.81
PM8500N	8500N	192.168.0.82
☑ ESP-88	ESP-88 1	192.168.0.160

NOTE: You must save the Project File to at least one system device so that it can be recalled in future connection sessions. Not doing this could cause you to lose information about the systems signal processing and control settings.

5. Select the desired device or devices and click **OK**.

6. Once the settings and Project File has been transferred to the devices you will be disconnected from the system.

Dante Digital Audio Networks

Dante™ Network Audio

Dante™ network cards are available for Bose engineered sound processors and PowerMatch® configurable professional power amplifiers. Each of these network cards use industry-proven Dante technology to transport multiple channels of high quality, uncompressed digital audio in real time across a standard Ethernet network.
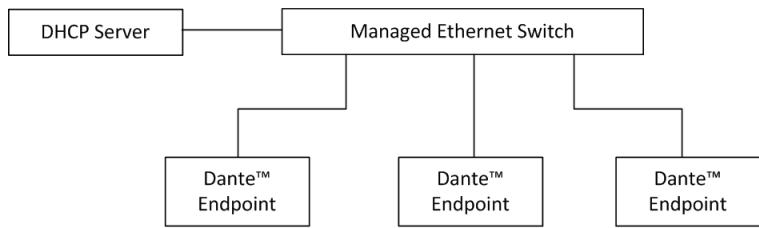
All Bose Dante network cards support both switched and redundant operation – allowing Bose engineered sound processors and PowerMatch amplifiers to be integrated into small systems without additional network hardware and into large systems utilizing multiple endpoints and redundant network design.

All ESP-880/1240/4120/1600 engineered sound processors are capable of receiving both ControlSpace control data and Dante audio data from the Dante network card. ESP-00 II/88 engineered sound processors and PowerMatch amplifiers do not have this capability and require a physically separate audio and control connection.

All Dante devices operate on a standard Ethernet network and use standard Ethernet switch hardware to manage data traffic.

Basic Dante Network
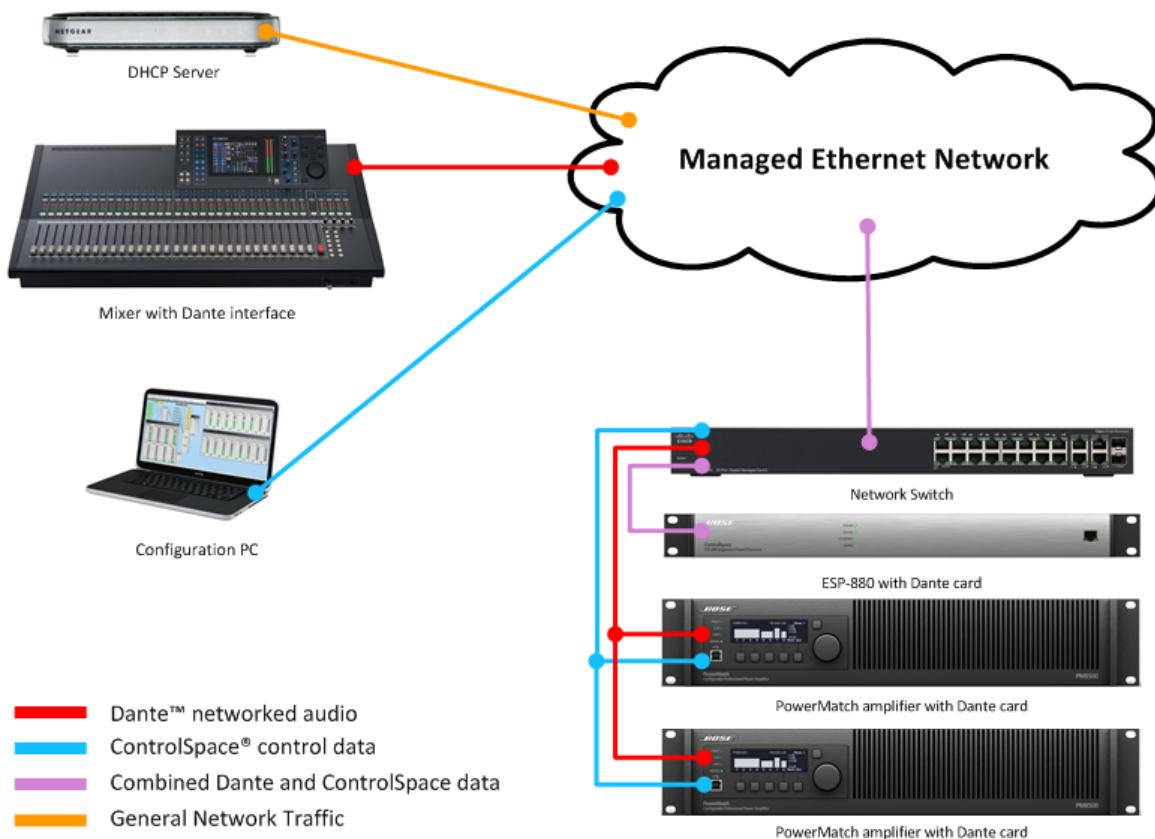
A basic Dante network consists of a managed Ethernet switch, Dante endpoints, and a DHCP server. Dante endpoints can be any type of device from any manufacturer, provided they support the Dante audio network protocol.

All Dante endpoint devices operate using DHCP as default, and will wait to receive a network address from the DHCP server. If a DHCP server is not present, Dante devices will default to a predefined IP address within the range of 169.254.x.x.

Combined Digital Audio and Control Network

A combined digital audio and control network integrates both control and audio data onto a common Ethernet network. Using standard network switch configuration parameters, it is possible to optimize the flow of both types of data traffic to provide the best system performance. The following example illustrates how Bose ControlSpace engineered sound processors and PowerMatch amplifiers are integrated into a Dante digital audio network.

Example system with Dante network audio

Bose® ControlSpace® ESP-880/1240/4120/1600 engineered sound processors can be easily integrated into a combined data and control network. PowerMatch® amplifiers require physically separate control and data connections

to the network, as does the ControlSpace ESP-00 II/88 engineered sound processor. In the case of the ESP-00 II and the CC-64 control center, these devices operate at a much slower network speed and require additional configuration when being integrated into a larger Dante digital audio network.
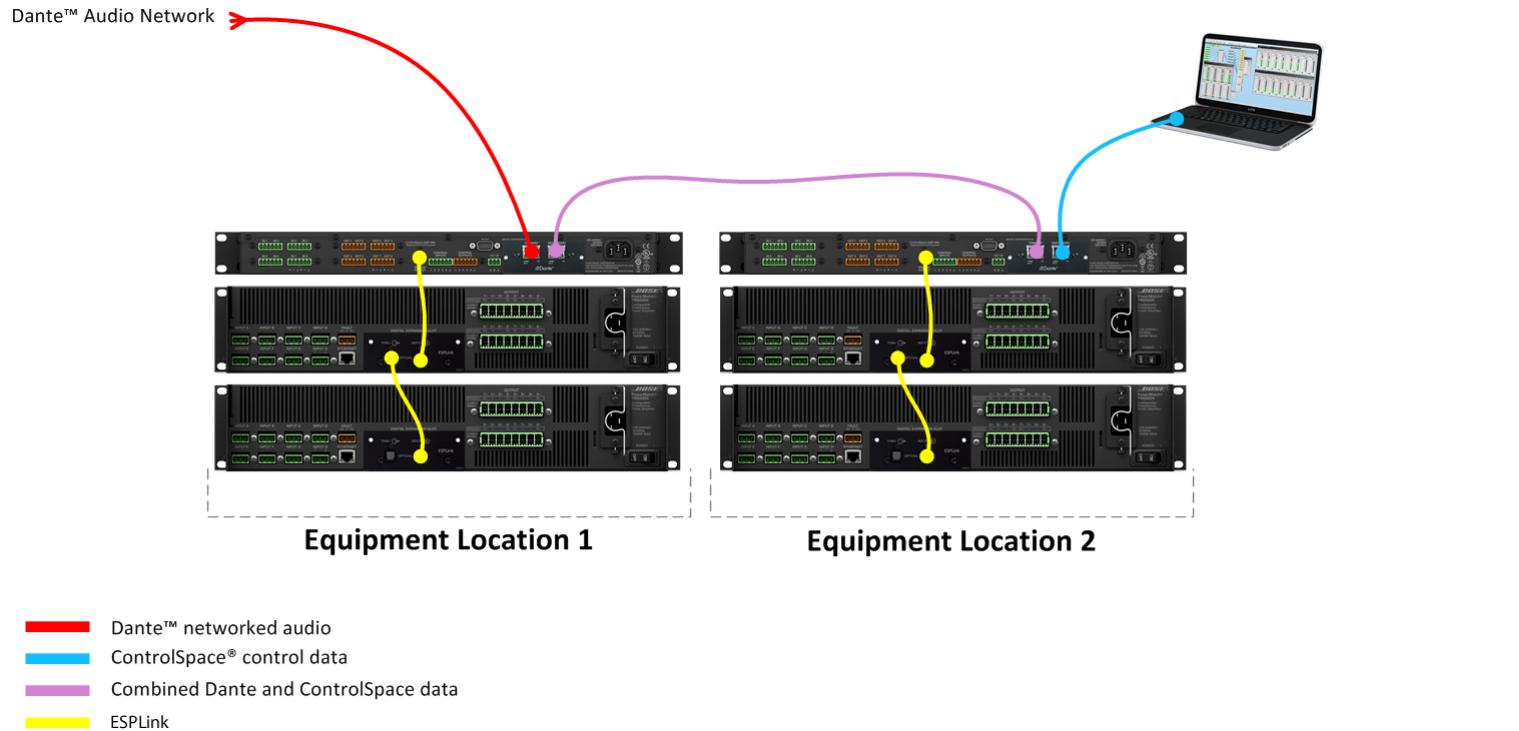
Dante™ System Configurations

Bose engineered sound processors and PowerMatch® amplifiers support a variety of configurations, from simple stand-alone systems which do not require additional network switch hardware to larger installed systems utilizing multiple end points and redundant network design. Each Dante network card for Bose devices supports four operating configurations: Switched Operation, Redundant Operation, Legacy Hardware Operation, and Isolated Networks (2-wire) Operation.

Switched Operation
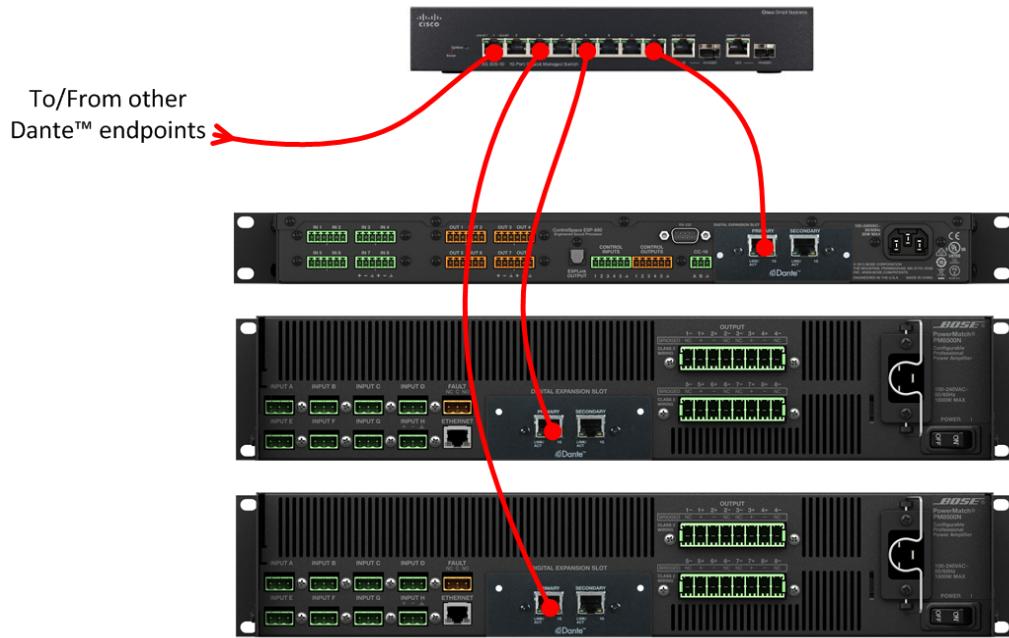
Switched operation is the default operating mode. Each Dante card contains an internal network switch to manage data traffic between the two network ports, Primary and Secondary. In Switched mode, it is possible to create basic system configurations which do not use any additional network hardware, greatly simplifying network set up and configuration.

In the following example, two equipment locations each contain an ESP-880 processor and two PowerMatch® amplifiers configured with ESP Link. A source device, such as a mixer using Dante technology, delivers digital audio to the first ESP 880 processor, and is daisy chained to the second location using the built-in network switch. In each location, audio is distributed to the amplifiers using ESPLink. A local PC is connected to the second ESP-880 processor for system configuration using ControlSpace® Designer software.

Switched Configuration Example 1: System using a built-in network to distribute network audio to two equipment locations
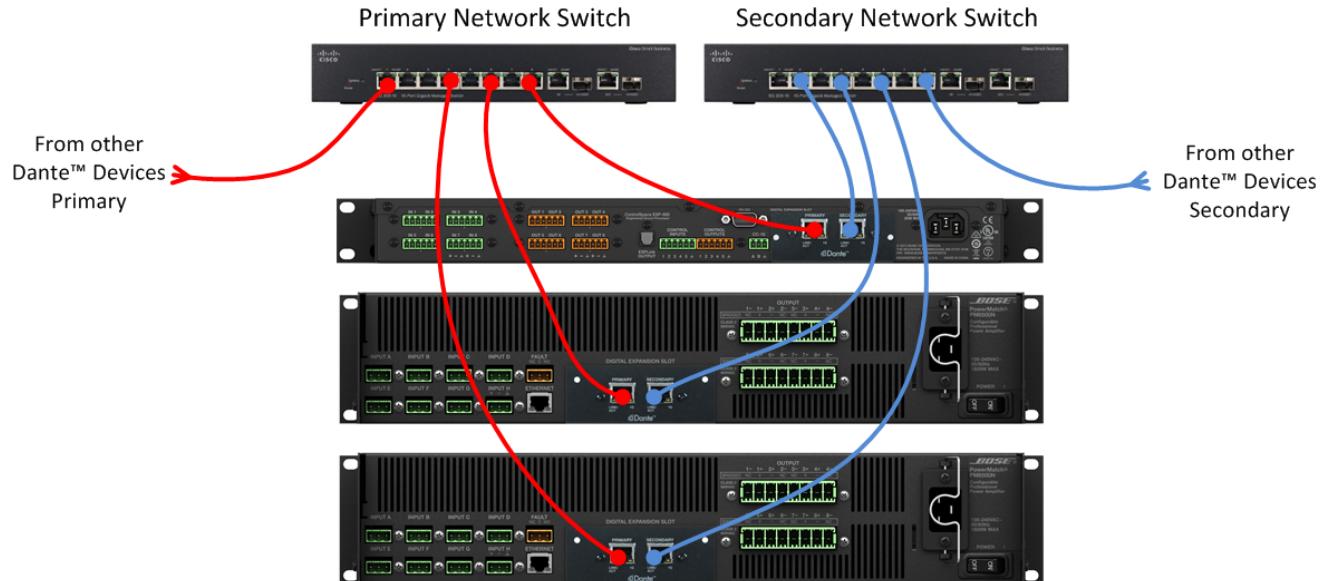
While the Switched mode allows for simplified wiring and configuration of basic systems, it also works well for larger systems with multiple endpoints. In this configuration, each device is wired directly to a managed Ethernet switch as shown in the following figure.

Switched Configuration Example 2: System using a standard network switch to distribute Dante network audio to Dante endpoints

Redundant Operation
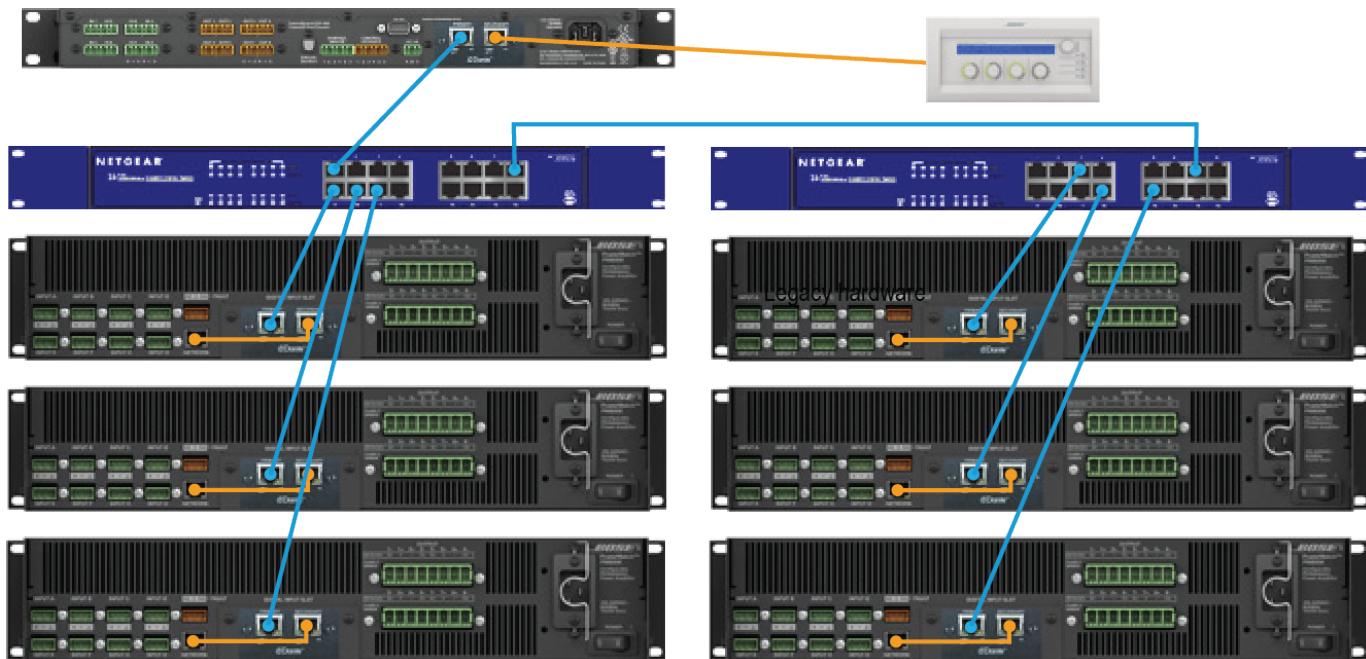
In Redundant configuration both the Primary and Secondary ports operate on separate physical networks, and use separate network addresses. If the Primary network data connection breaks, the Dante network card immediately switches to the Secondary network. When the Primary network is restored it again becomes the main source of audio data. The diagram in Figure 5 illustrates an example of redundant network wiring.

Redundant Configuration Example

Legacy Hardware Operation
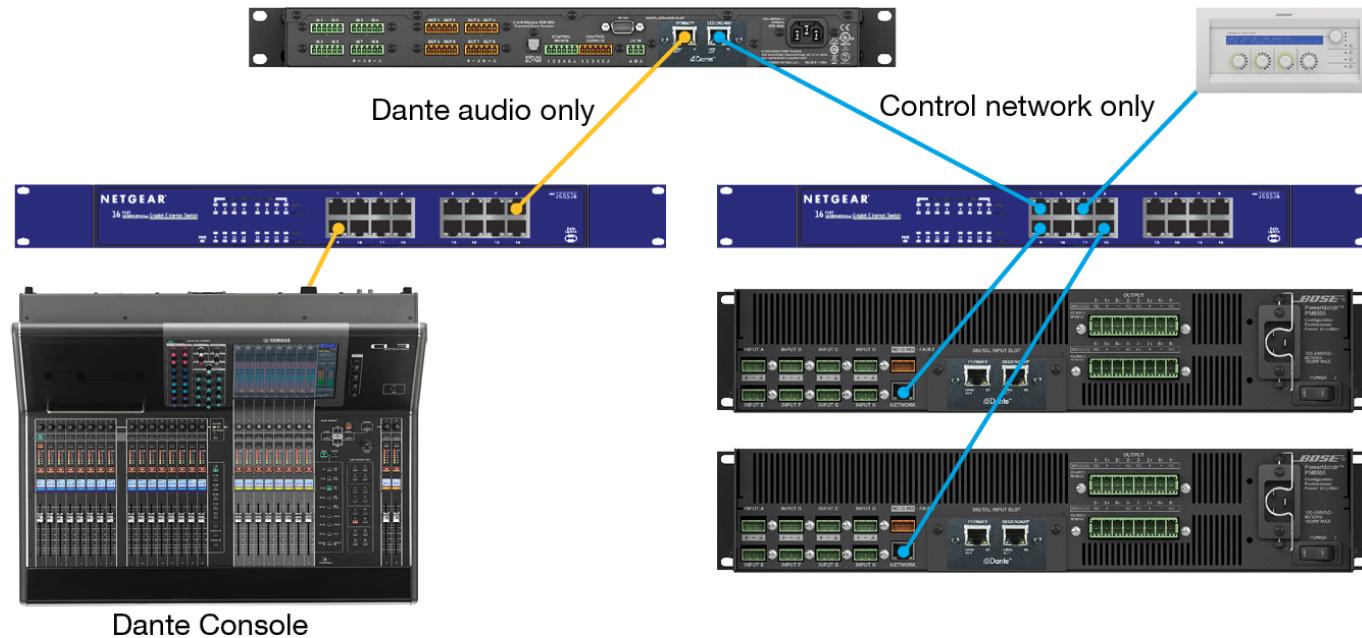
In the Legacy Hardware configuration, the Primary port is used for Dante audio and control. The Secondary port is used only for control connections to legacy hardware such as the ESP-88/00 and CC-64.

Legacy hardware

Legacy Hardware Configuration Example

Isolated Networks (2-wire) Operation

The Isolated Networks configuration is available only for the ESP-880, ESP-1240, and ESP-4120 processors which are limited to two-wire operation. This configuration can be applied to cases where an installation needs to keep Dante enabled devices on one network while ControlSpace devices are on another.
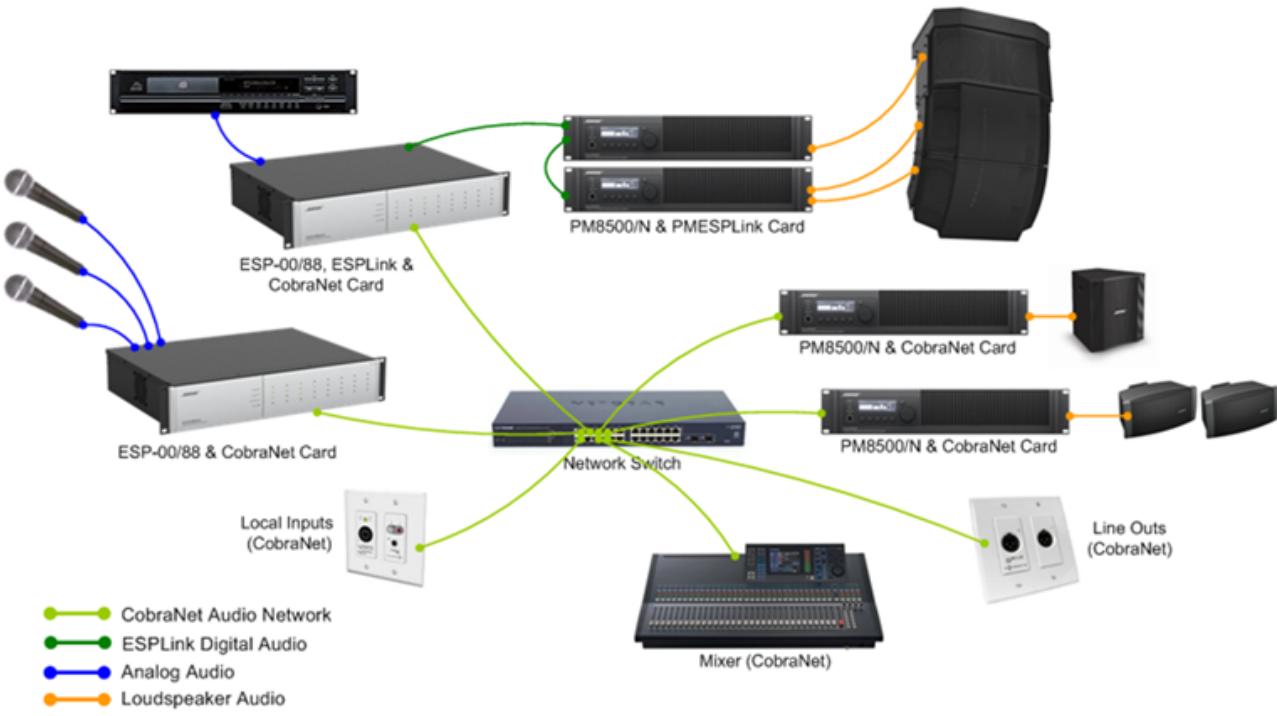
Isolated Networks Configuration Example

CobraNet Digital Audio Networks

CobraNet® Network Audio

CobraNet network audio expansion cards are available for the ESP-00 II/88 engineered sound processor and the PowerMatch® configurable professional power amplifiers. The cards use industry-standard CobraNet technology to transport multiple channels of high quality, uncompressed digital audio in real time across a standard Ethernet network. CobraNet network audio distribution is typically used in systems which require signal processors and amplifiers are in different parts of a large building or complex, or to interlink multiple devices within an equipment rack to reduce analog cabling and connections.
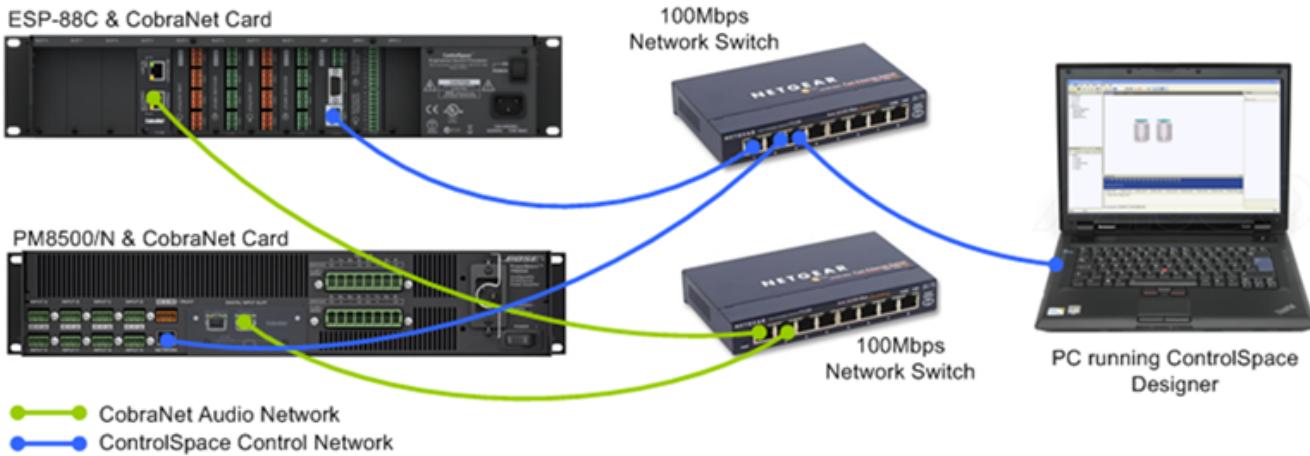
Example system using CobraNet network audio distribution

A CobraNet audio network is built using a standard 100Mbit (Fast Ethernet) or 1000Mbit (Gigabit) Ethernet network and can utilize industry-standard structured network cabling (CAT5E/CAT6), Ethernet switches and other network components.
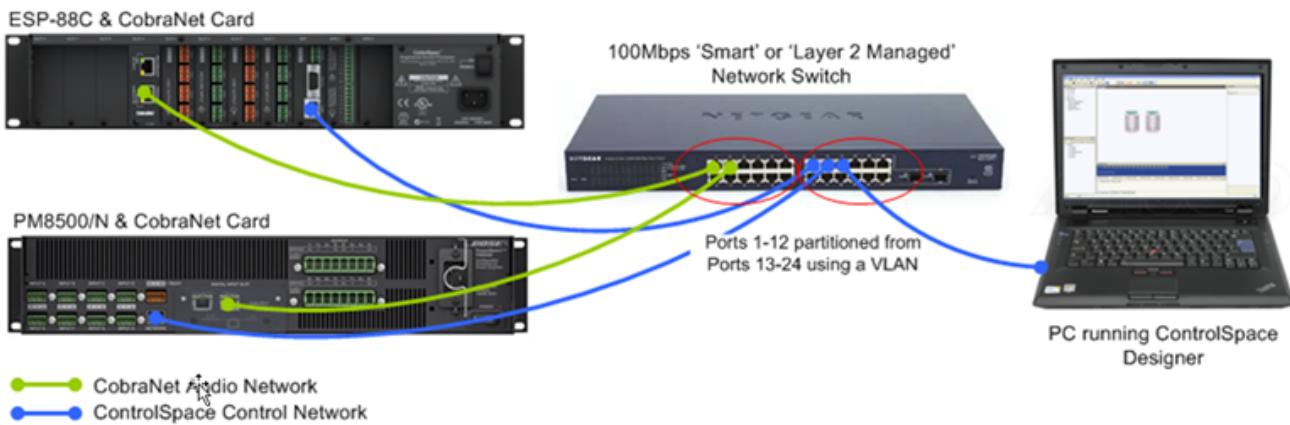
While systems using less than 8 CobraNet audio "bundles" may use a standard Fast Ethernet router, we recommend that a standard Ethernet switch is used to avoid complications. For Larger systems, and in systems which require quality of service (QoS) management, a managed switch is recommended. The use of repeaters/hubs, however, is not recommended and should be avoided.

When using CobraNet with ControlSpace devices, the CobraNet audio data and the ControlSpace control data must be isolated from each other using physically separate networks as the volume of traffic produced by CobraNet is incompatible with the 10Mbit control connection found on some ControlSpace devices.

Example implementation of audio and control networks using physically separate networks
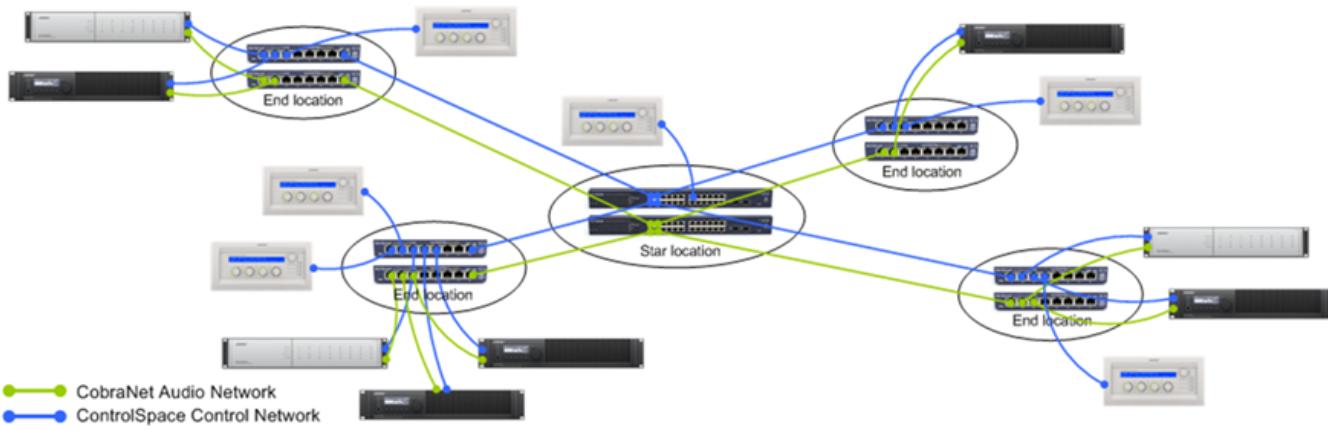
If a managed switch will be used in the system, the creation of a separate VLAN for one of the two networks is acceptable. Using a "Smart" or "Layer 2 Managed" Ethernet switch that supports VLANs, it is possible to partition the networks within a single switch as shown below.

Example implementation of audio and control networks using a VLAN
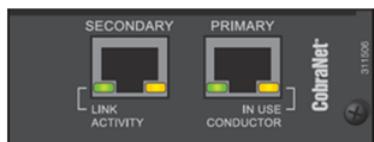
In order to avoid unwanted audio artifacts and drop-outs the CobraNet network relies on the timely delivery of audio data and therefore has some fairly strict network requirements. Each time a switch is inserted in the transmission path between the sending and receiving device, known as a 'switch-hop', a small amount of propagation delay occurs. In order for this delay to not affect correct operation a maximum of six 'switch-hops' is recommended for 100Mbit networks, (when using the Standard [5.33mS] latency option). Since 1000Mbit network switches are designed to operate at faster speeds their propagation delay has less significance.

Consistent with most computer based Ethernet networks (and the ControlSpace control network), CobraNet networks typically use a 'Star' or 'Star of Stars' layout. In the example shown below a maximum of three switch-hops is required to reach any other device on the network.
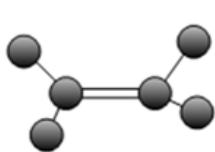
Typical 'Star of Stars' network topology

Each CobraNet network audio interface includes two physical connections, Primary and Secondary, but only use one at any given time. The Secondary port adds redundancy and is used automatically should the Primary connection to the network fail.
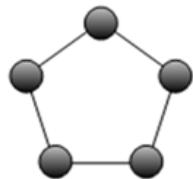
CobraNet Audio Network Card
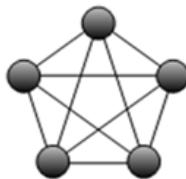
While the two ports provide redundancy for the connection between the CobraNet card and the network, the resilience of the complete connection between CobraNet devices will depend on the network design. Various techniques and protocols exist to provide automatic backup and redundancy for Ethernet networks. Some of these are shown below:
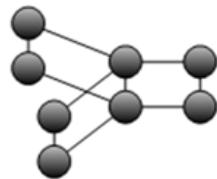
Link aggregation/Trunking   Ring (with Spanning Tree)   Meshing   Dual Link (with Spanning Tree)

Redundant network topologies

See CobraNet_Input_Output.htm for the ESP-88/00/00 II.

See Configuring_the_PowerMatch_CobraNet_card.htm for the PM8500/N, PM8250/N, PM4500/N and PM4250/N.

CobraNet® is a trademark of Cirrus Logic, Inc.

CobraNet® Network Audio Routing

Within a CobraNet® network, audio is passed between devices in Bundles; each Bundle can carry up to eight audio channels. Each CobraNet device may be configured as a transmitter, receiver or both. The exact channel count capabilities of the device are somewhat dependent upon the hardware and are typically pre-determined by the manufacturer.

A CobraNet receiver may be connected to only one transmitter which must be on a different device. The CobraNet Bundle assignment is the method by which devices determine how audio data is routed throughout the system. The Bundle address also is used to determine the transmission method for the audio data:

Multicast method: When a transmitting device broadcasts its audio data to the network and may be received by any receiving device.

Unicast method: When the transmitting device broadcasts its audio data to a single receiving device.

The Bundle address given to a transmitting device determines whether the data will be broadcast using the Multicast or Unicast method. Bundle numbers are normally in the range 1-65,279 with 1-255 defined as Multicast and 256-65,279 usually defined as Unicast.

Examples of Unicast and Multicast audio routing.

The type of broadcast method used will directly affect the amount of data being transmitted via the network. While both types can only be sent by a single transmitter, and Unicast Bundles can typically only be received by one receiver, a Multicast Bundle can be received by any number of devices, but adds additional network traffic and should only be used if required. A Multicast Bundle will normally be sent to every port on the network irrespective of whether any receivers are requesting it. Whereas, a Unicast Bundle is only sent to a network port leading to the CobraNet device requesting it. Otherwise, it is not transmitted. Eight bundles on any port (including all the Multicast Bundles on the network) will consume all the available bandwidth on a 100Mbit network and hence a maximum of four Multicast Bundles is generally accepted good design practice.
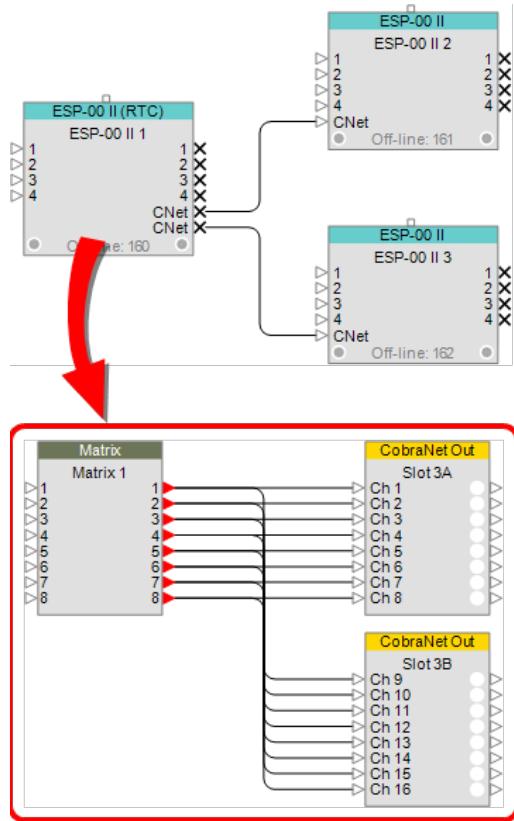
NOTE: It is possible for Bundles in the Unicast range (256-65,279) to be set to Multi-Unicast (allowing a copy to be received by up to four devices) or Multicast, but these modes are rarely used and are not currently supported within ControlSpace Designer software.

The next two examples show audio routing for typical applications.

Example 1 – audio distribution between multiple processors.

The CobraNet card in ESP-00 II 1 is configured as "16out" and the others as "8in". One Bundle of eight channels passes from ESP-00 II 1 to ESP-00 II 2 and a different Bundle of eight channels passes from ESP-00 II 1 to ESP-00 II 3.

If desired, some or all of the channels in each Bundle can be the same simply by linking the same paths to each CobraNet output module. This is beneficial in that both connections are still from a single transmitter to a single receiver, hence, Unicast Bundles (256-65,279) can be used, preserving network bandwidth.
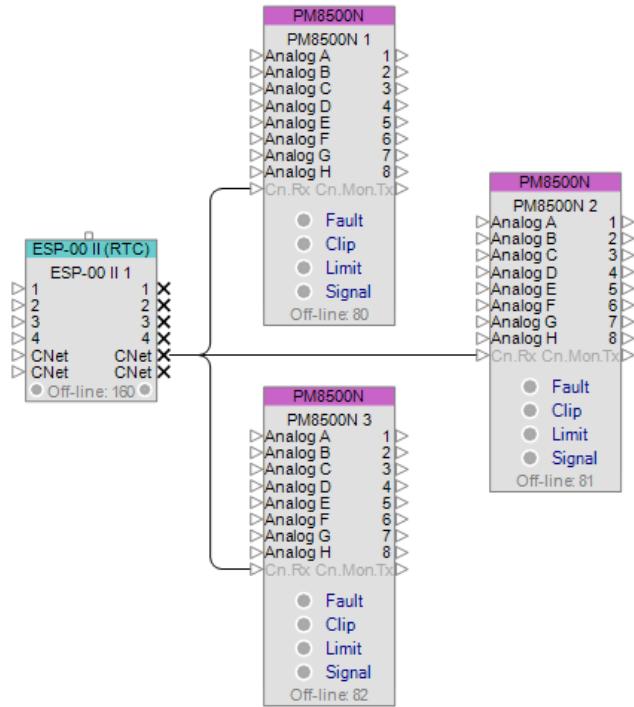
Example 2 – audio distribution to a remote amplifier rack.

In this example, audio is routed from a single ESP-00 II to a remote amplifier rack containing three PowerMatch® amplifiers.

With this design, a single Bundle of eight channels is passed from ESP-00 II 1 to all other devices. Since these connections are from a single transmitter, but to multiple receivers, a Multicast Bundle (1-255) would be required.

Being a common scenario, this is a supported out-of-the-box configuration requiring minimal setup.

PowerMatch CobraNet cards come factory set to receive Bundle 100, and with ControlSpace Designer v3.1 or later, the first ESP-00 II CobraNet transmitter in the design will be set automatically to the same Bundle. Hence, once the cards have been physically added and connected, simply uploading the design file to the ESP-00 II is all that is required to establish the link. Routing audio to the CobraNet output module in the ESP-00 II and selecting the Digital source on the amplifiers will then allow audio to pass.
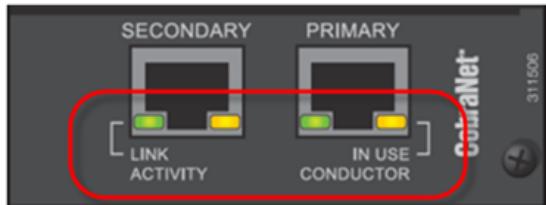
CobraNet Network Status

The most critical component to any networked audio system is that audio is reproduced simultaneously from all system devices. In a situation where a single transmitter is configured for Multicast operation, all receiving devices must synchronously reproduce the audio. If this does not occur the quality of the audio at the listener has the potential to be greatly reduced. To keep all the CobraNet devices synchronized, one node takes on the role of 'Conductor' and generates regular 'Beat' packets that are broadcast to all of the other devices, 'Performers', on the network. Performers use the beat packets to synchronize audio playback and to synchronize their digital clocks locally.

Only one device on the network can be the Conductor, all other devices are performers. If the device identified as the Conductor drops out, after a period of time a new device will step up and fill the role of Conductor to ensure seamless, synchronous operation.

A second important aspect of the network status is that transmitting and receiving devices are configured properly. For example two devices transmitting on the same Bundle number or the presence of a large number of Multicast bundles can lead to network errors. Normally, the settings provided within ControlSpace Designer software will help ensure a proper setup and normal operation. However, it is possible to modify settings using other CobraNet network utilities and create issues with the audio routing, affecting the network status.

Each CobraNet port has two LEDs to indicate the current network status:
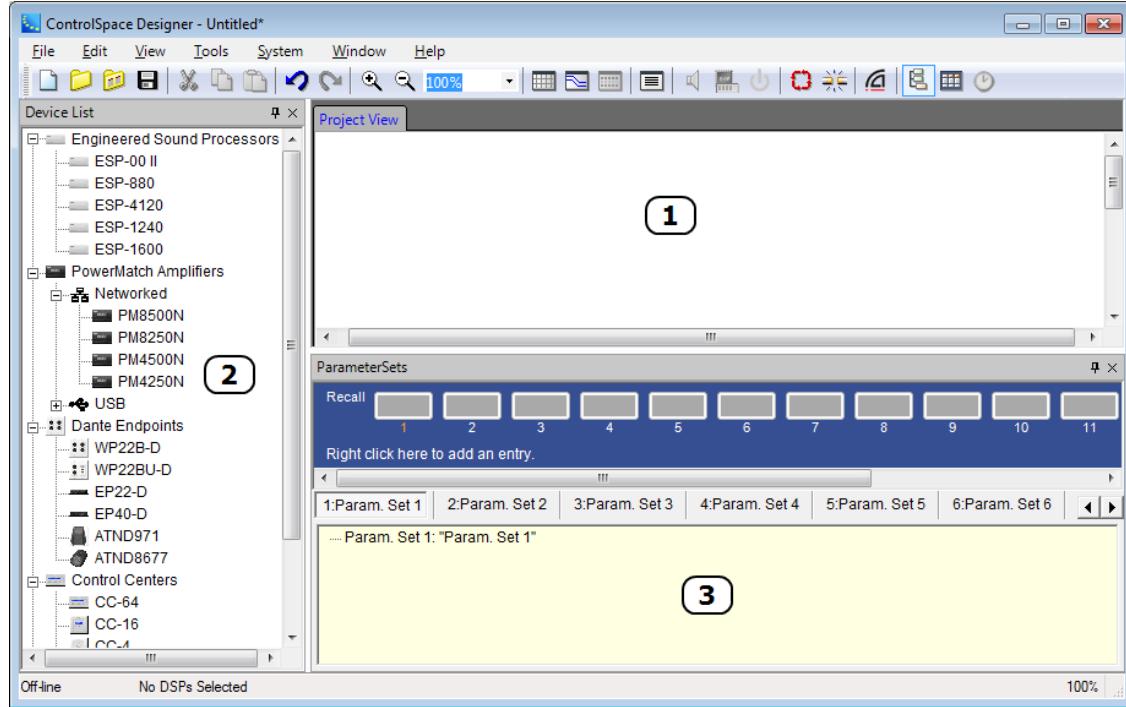
LED Color	Action	Status
GREEN	Solid	Link established with another node or networks switch
GREEN	Blinking	CobraNet activity on the network
ORANGE	Solid	Power applied, node is a Performer (default)
ORANGE	Blinking - single port	Node is the Conductor
ORANGE	Blinking - both ports	Error on the network

User Interface

Interface overview

The ControlSpace® Designer™ software interface consists of three primary areas:

1. **Design Workspace** - Used to define system devices, create signal processing diagrams, and to access operational screens for various devices and signal processing objects.

2. **Device List**/**SP Toolkit (ESPs)** - A context-sensitive panel that lists devices that can be added to the system design in Project View, or when an ESP device tab is selected, lists signal processing tools.

3. **Control Library** - Used to display system control functions placed in Parameter Sets, Groups, and Timers.
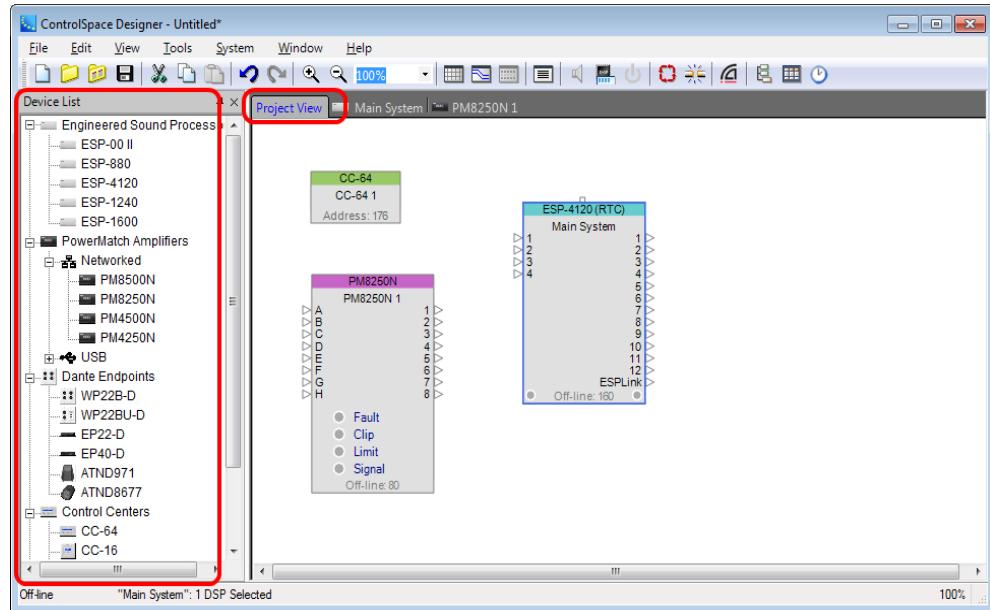
While a number of additional views, and windows are available, these three elements are the primary work areas.

Windows Reference

Design workspace
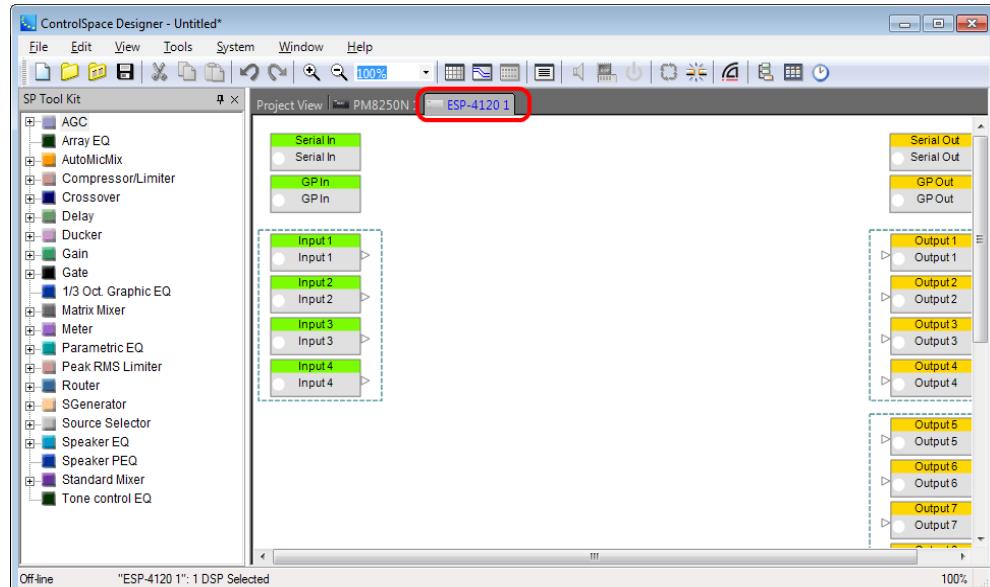
The Design Workspace is used to define the system devices, create the signal processing diagram that will be implemented within the ESP, and to access the operational screens for various devices and signal processing objects.

Create your system design by selecting, dragging and dropping individual processing and control components from the **Device List** into the **Project View**. The **Project View** represents a block diagram of all system components and their interconnection.
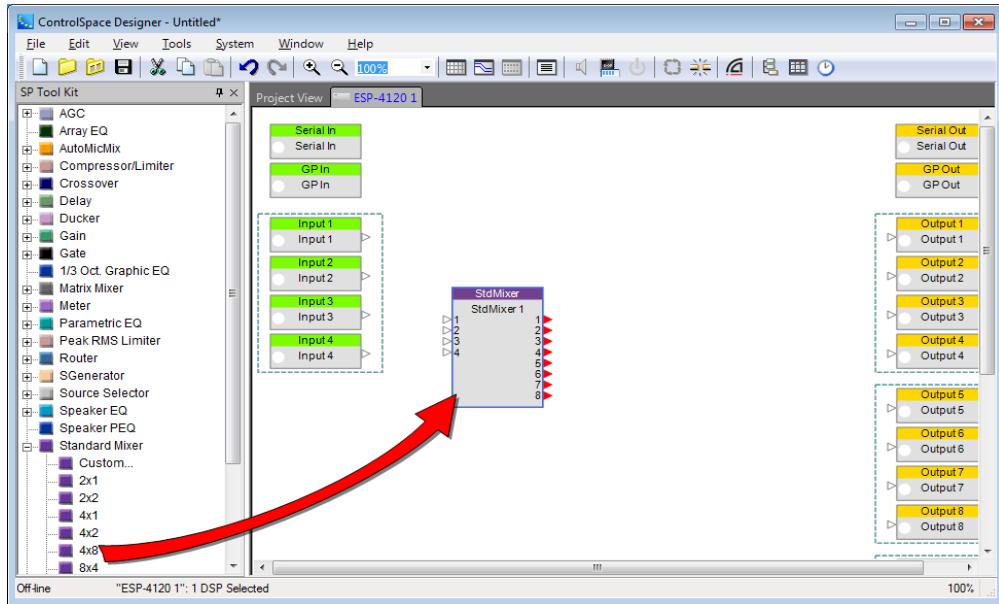
Device Tab

Once a system component is added to the design, a new **Device Tab** for the component is created. Selecting the **Device Tab** displays the signal processing diagram for the device.
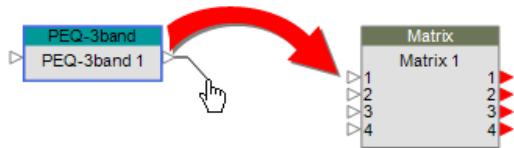
SP Tool Kit

The **SP Tool Kit** contains all the available signal processing blocks for use in the selected device. Simply drag and drop these blocks into the **Signal Processing View** on the right to configure your system.

Wiring Devices
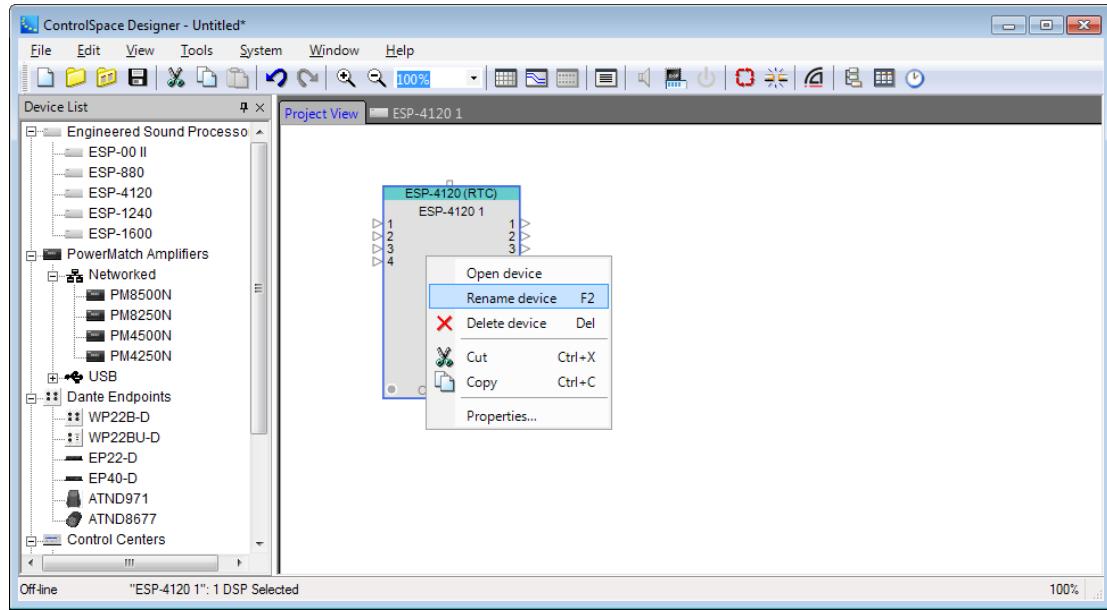
Wiring devices between inputs, outputs and signal processing blocks is accomplished by selecting the output node of the sending device and dragging it to the input block of the receiving device.
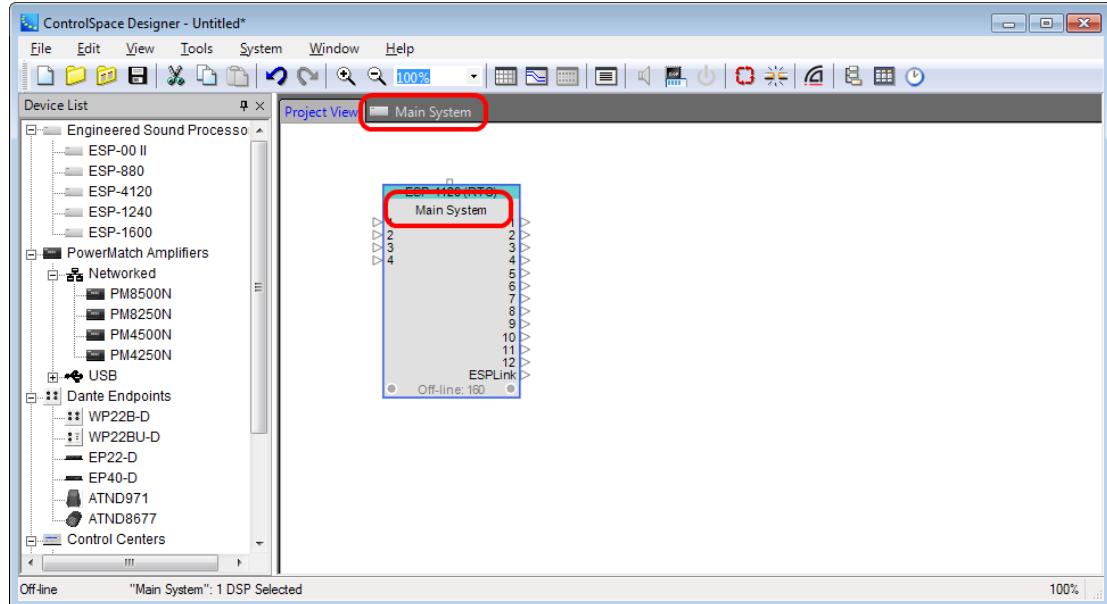
NOTE: The wiring shown in the Project View is representative and it does not affect the signal path. As such, not including wiring in the Project View will not affect the operation of your design. However, the devices within the Signal Processing View must be wired together to successfully route audio from inputs to outputs.

Renaming a Device

All devices displayed in the Project View have a user-definable label. To rename a device, right click on the device icon to display the context menu and select **Rename**.
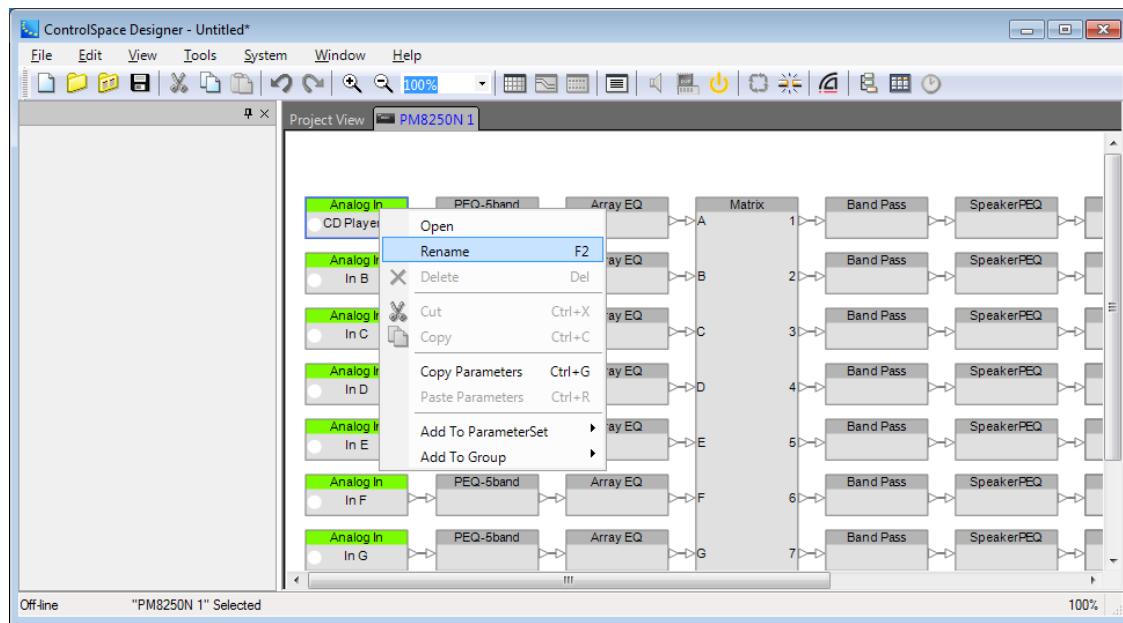
Once the new label is entered it is displayed on the device.
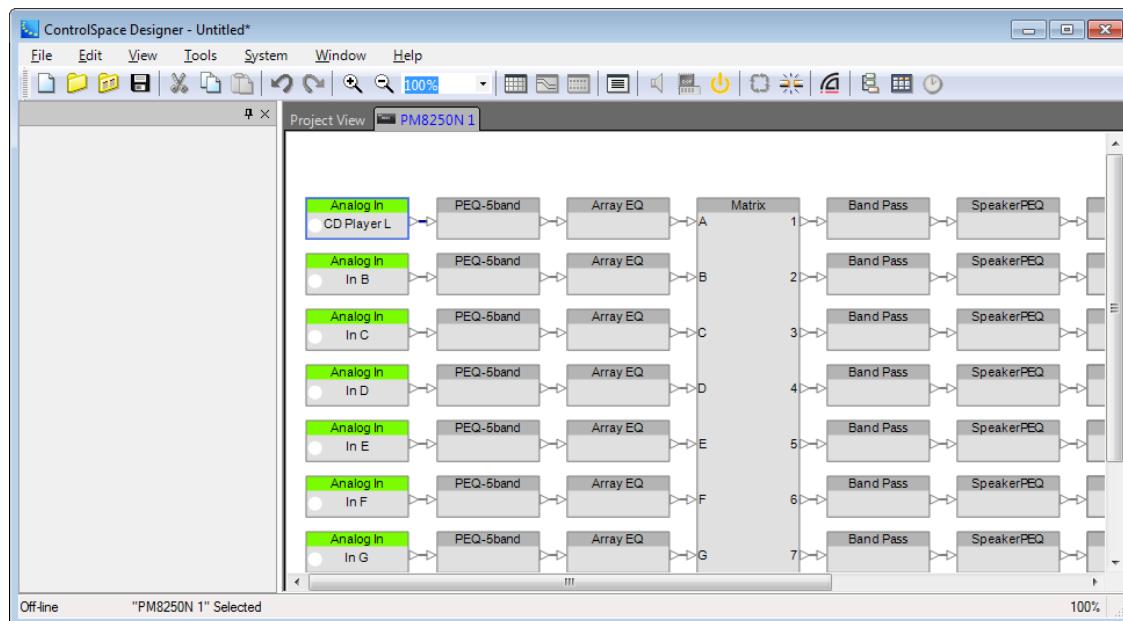
Renaming a signal processing block

All signal processing blocks displayed in the Signal Processing View have a user-definable label. To rename a signal processing block, right click on the icon to display the context menu, and select **Rename**.
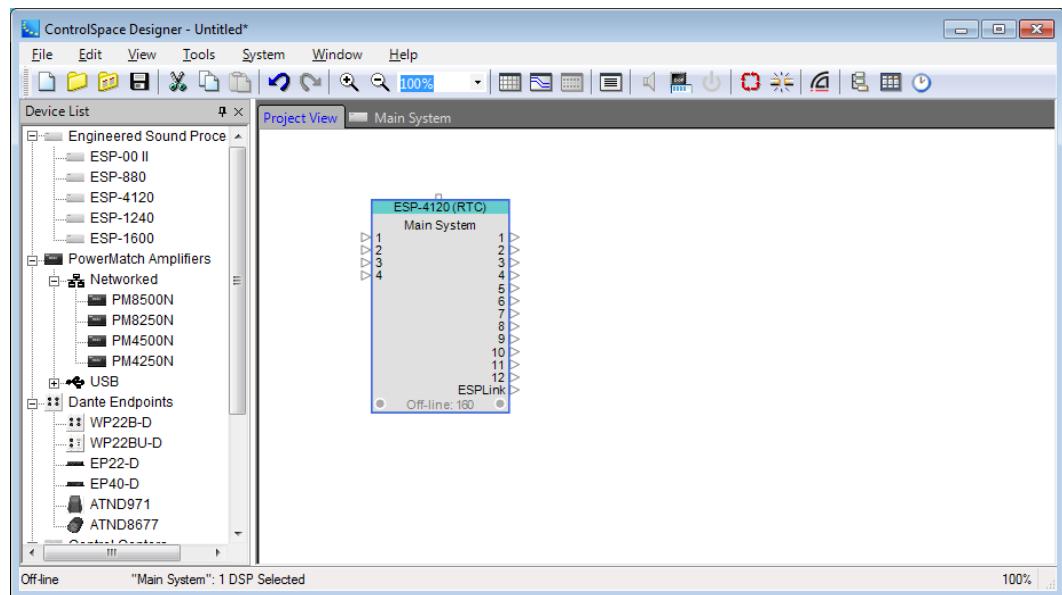
Once the new label is entered it is displayed on the signal processing block.
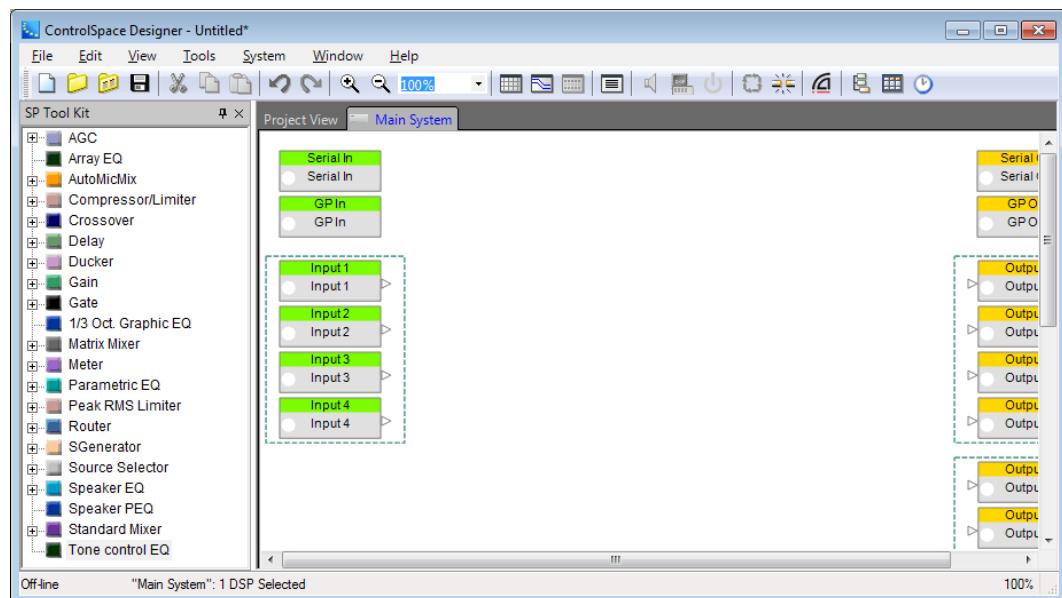
Device list

The **Device List** contains a list of devices which may be added to the Design Workspace. The available devices in the Device List are dependent upon the device tab selected in the Design Workspace.
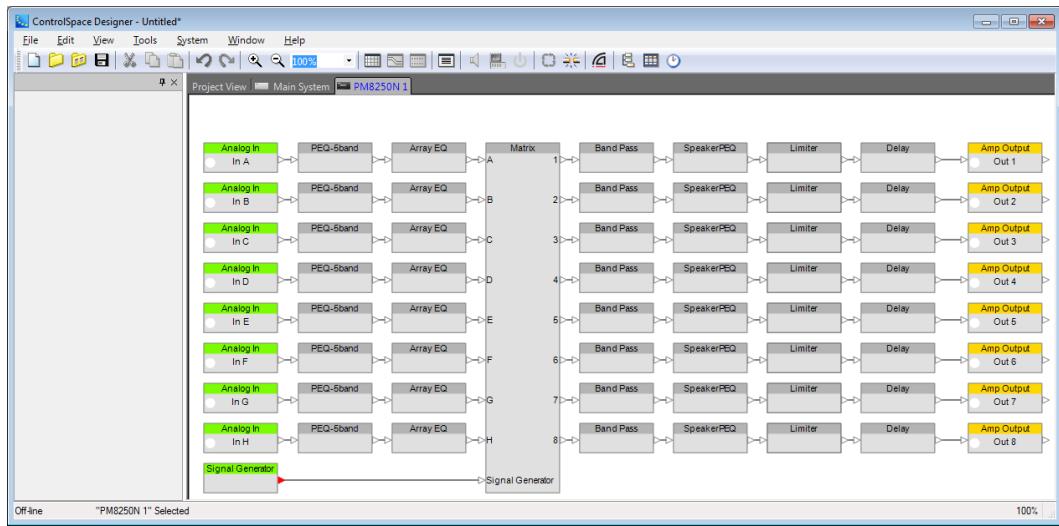
Device List - Project View tab selected

SP Tool Kit - ESP-4120 signal processing tab selected

Some devices, such as the PM8250N below, have a fixed, non-configurable, signal processing diagram. When the Signal Processing View for a fixed block diagram device is active the SP Toolkit is empty indicating that no additional signal processing may be added to this device.

PM8250N signal processing view

Control Library
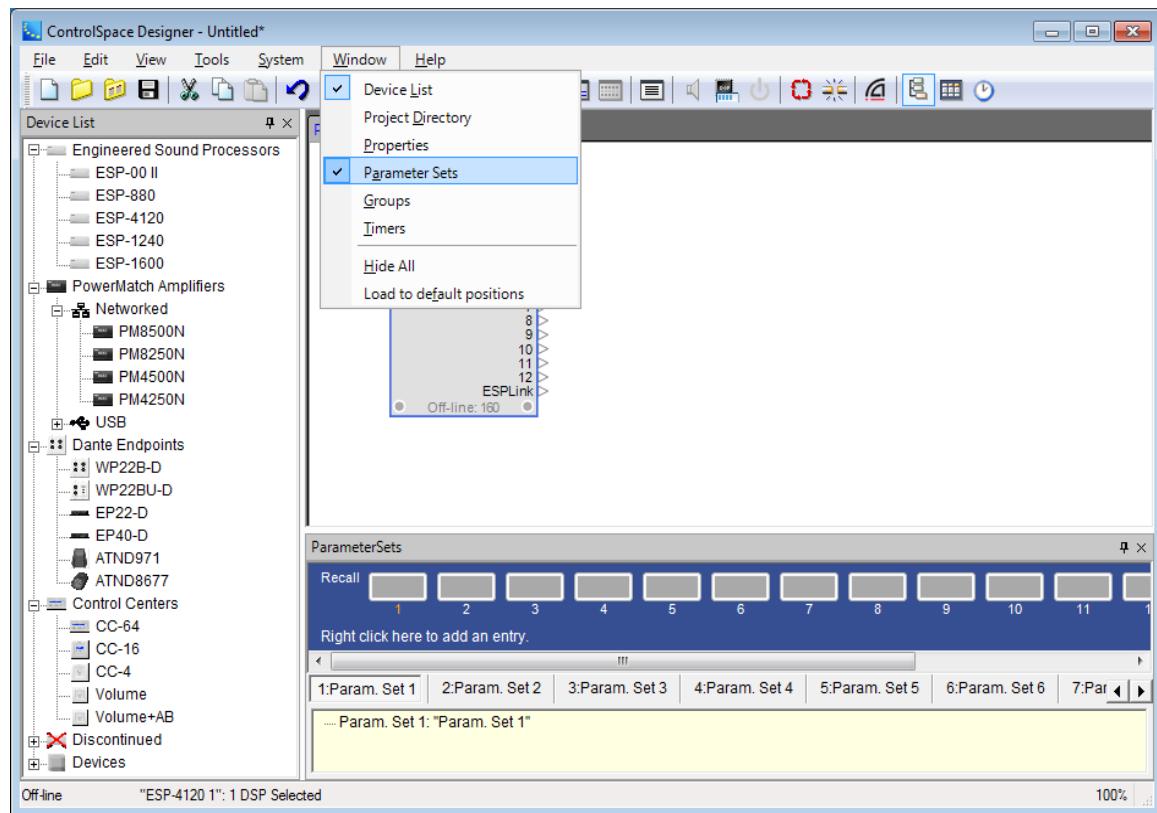
Control Library functions

A ControlSpace system may be controlled through a variety of methods - ControlSpace Control Centers, general purpose interfaces, serial data control, etc. The commands issued by the control devices either directly control signal processing objects, such as a gain control, or trigger a state change to one or more signal processing devices.
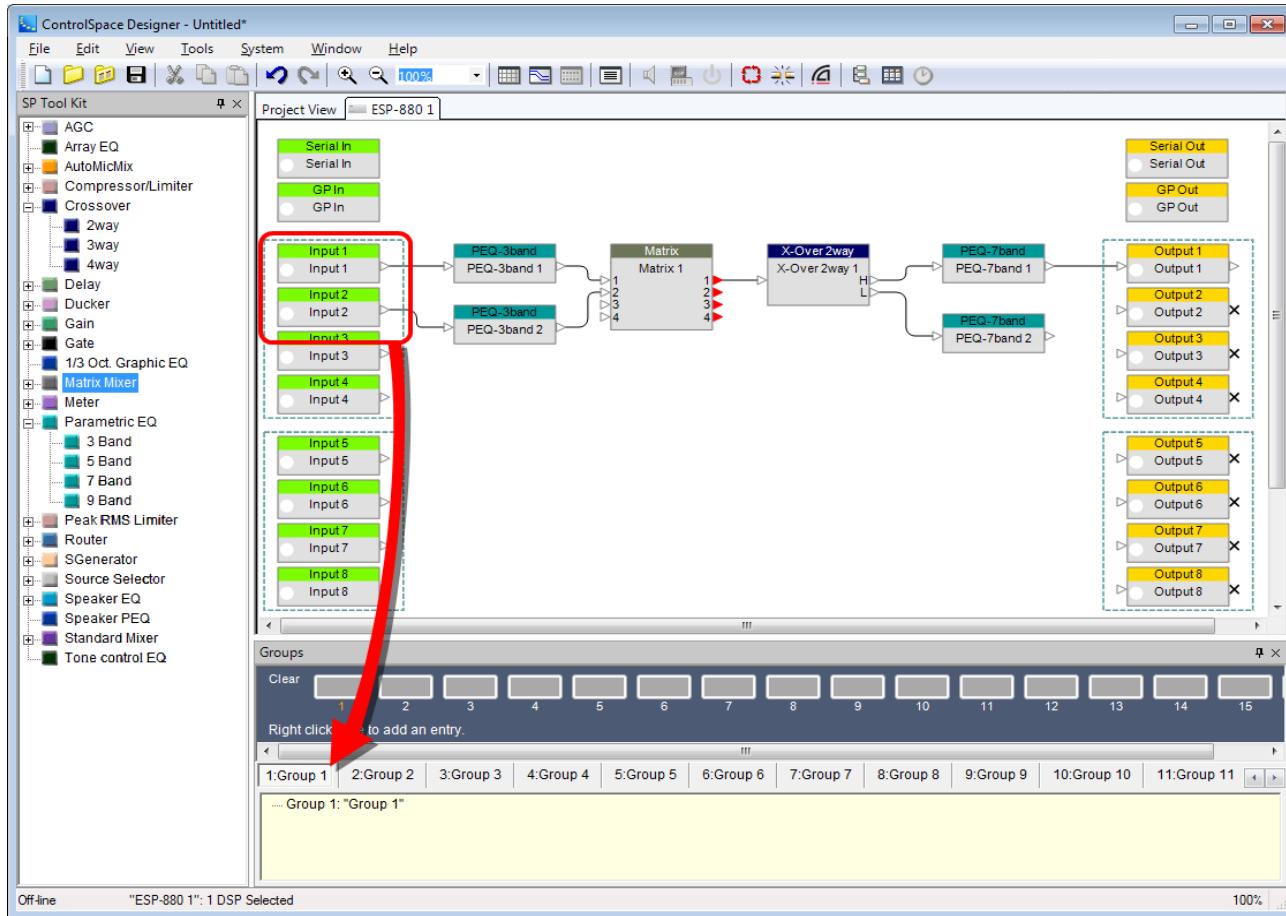
The Control Library contains four types of control functions:

- Parameter Sets
- Groups
- Timers

Access the Control Library from the Window menu; from here you can open the Parameter Sets, Groups, Timers, and Presets windows.
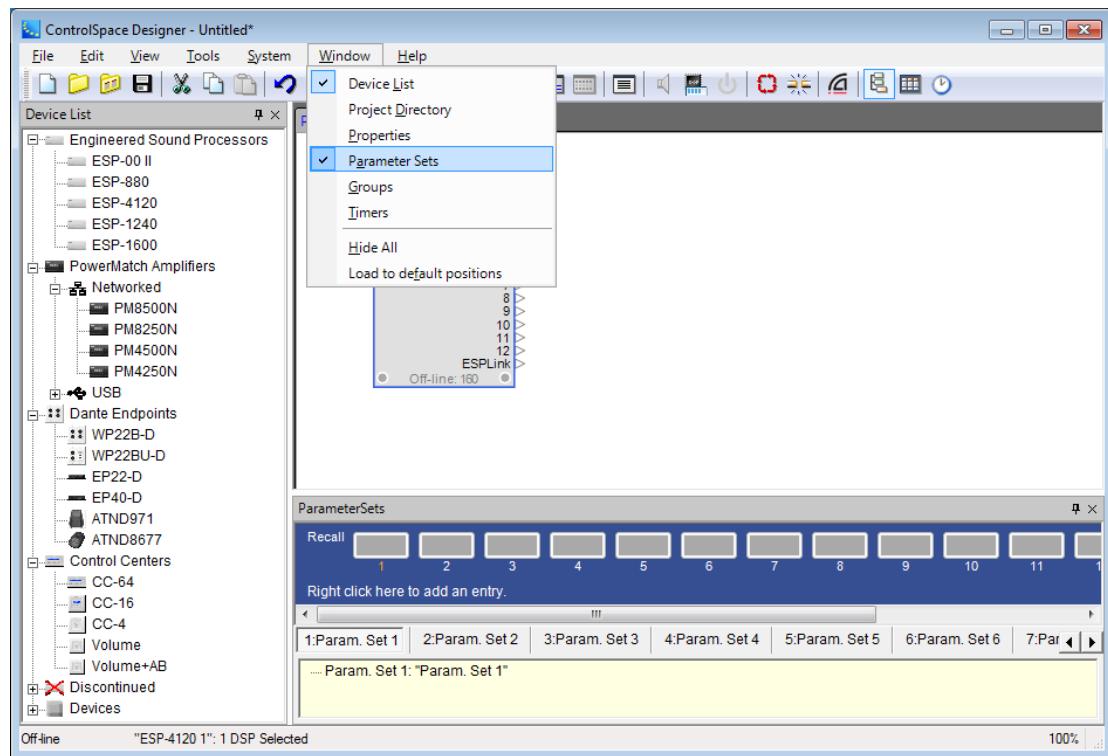
Control Programming is done through drag and drop. For example, to control two input gains using a single master gain, select the two input gains within the Signal Processing View, and then drag them to the next available Group within the Group Tab of the Control Library.

Parameter Sets Window

Parameter Sets store the current state of selected devices or signal processing blocks. When recalled the saved state is restored. All programming associated with Parameter Sets is stored within the ControlSpace Project file. Once the file is uploaded to the system, Parameter Set programming is stored within individual system devices.

To create new and view active Parameter Sets, select **Parameter Sets** from the **Window** menu.

Parameter Set programming is accomplished using drag and drop. Individual devices, signal processing objects or object properties may be dragged to a specific Parameter Set. When the Parameter Set is invoked, or recalled, the state of the object at the time of programming will be restored.

From within the Parameter Sets window the following functions are available:
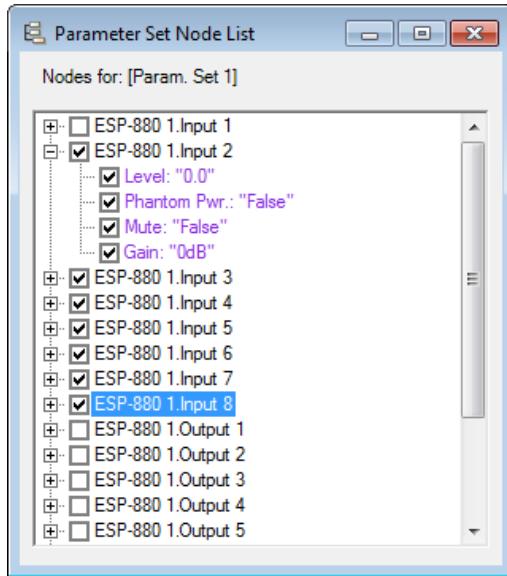
Recall Parameter Set – Selecting this item recalls the stored Parameter Set settings.

Add Parameter Set – Right-click anywhere on the blue area of the Parameter Set window to add a new Parameter Set

View Parameter Set – Select the desired Parameter Set Name to view the device settings associated with the Parameter Set

Edit Parameter Set – expand the tree view of the selected Parameter Set to view and edit device settings.

Double-clicking on the top level of the tree view for a Parameter Set will display the Parameter Set Node List. This tree view shows all available system devices and their settings available to be used within a Parameter Set. Selected items are those that are included within the Parameter Set.
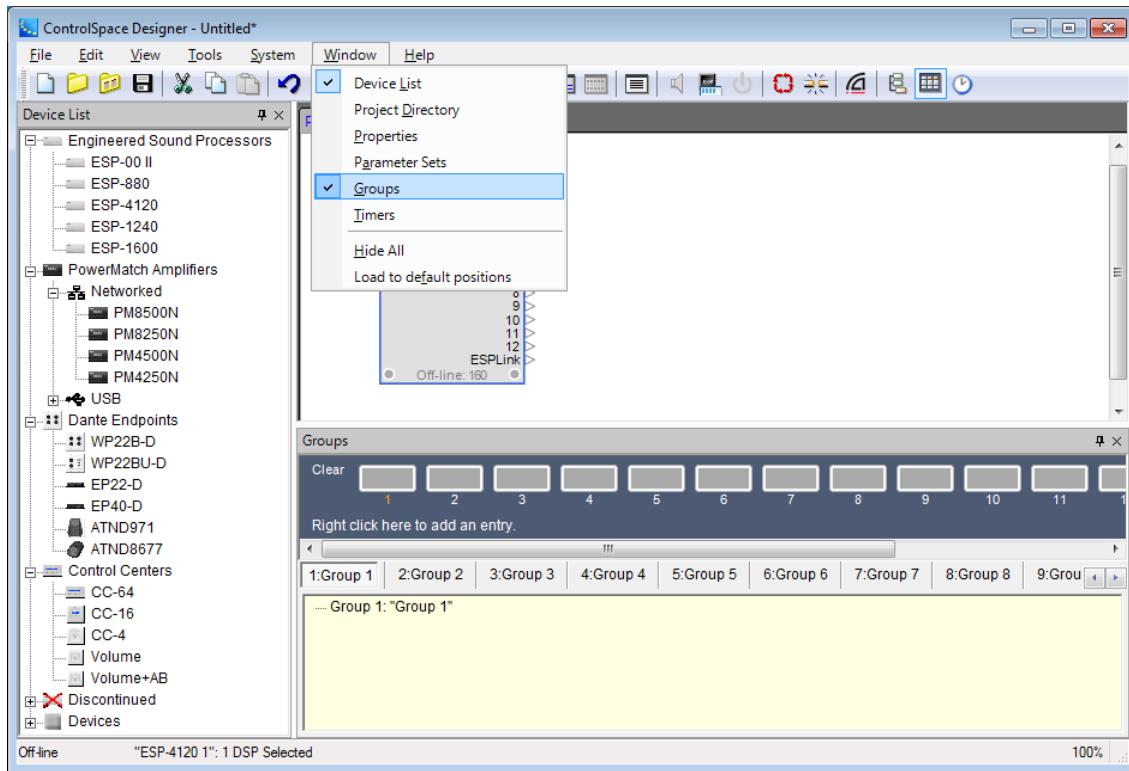
NOTE: It is possible to streamline Parameter Set programming by only including those device settings which will be affected by the Parameter Set. For example, when including an output gain change in a Parameter Set the mute property can be removed. This simplifies programming and reduces file size in systems with a large number of Parameter Sets.

Groups Window

Groups provide for the control of multiple like control panels from a single control. An effective use of groups is the combining of multiple gains into a single master gain, or multiple crossovers into a single group crossover.

When creating groups it is important to remember that only like processing blocks may be grouped to a single control.

To create new and view active Groups, select **Groups** from the **Window** menu.

Group programming is accomplished using drag and drop. Multiple signal processing objects of the same type, input gains, output gains or gain blocks may be dragged to a specific Group. When a Gain group is invoked a master gain control will be displayed. Signal processing object groups operate using linked controls – changes made to any one member of the group is reflected in all members.

From within the Groups window the following functions are available:

Clear Group – Selecting this item removes all signal processing devices or gains from the selected group.

Add Group – Right-click anywhere on the blue area of the Groups window to add a new Group.
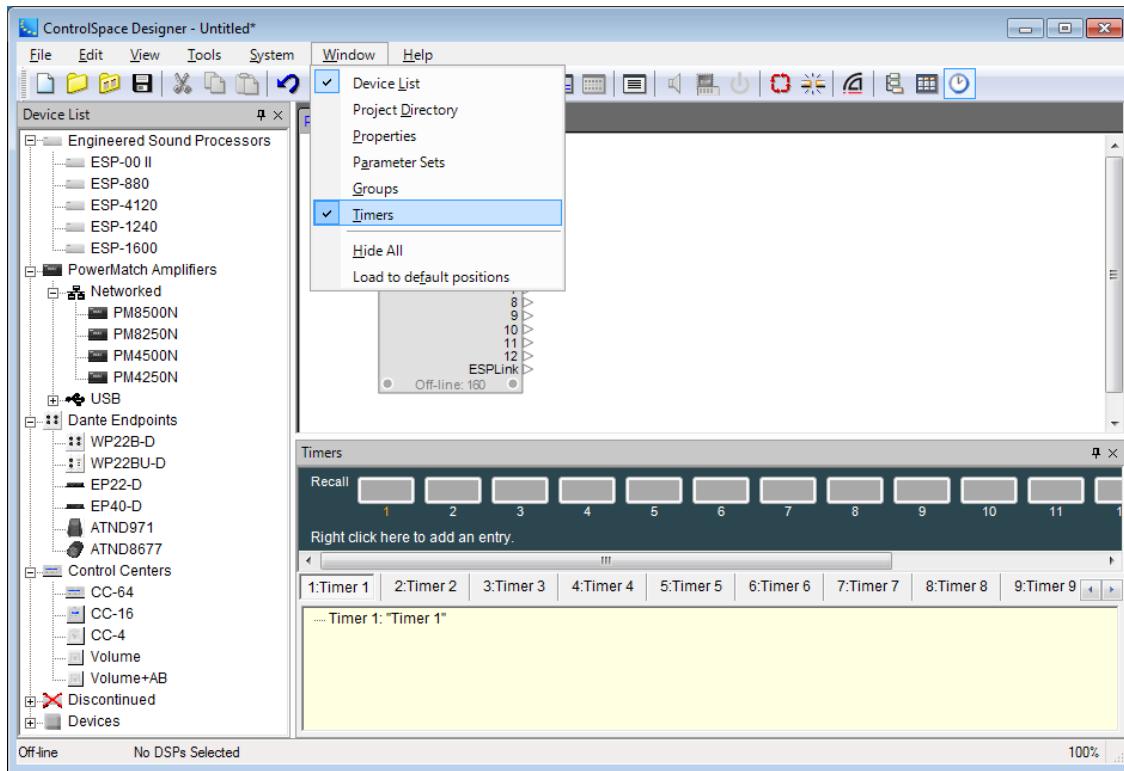
View Group – Select the desired Group name to view the signal processing devices or gains associated with the Group. Double click on the top level of a gain group's tree view to display the master volume control panel.

Edit Group – expand the tree view of the selected Group to view and edit its settings.

Timers Window

Timers are used to invoke a specific signal processor state, or Parameter Set at a specific day or time. Timers are only available when the system includes an engineered soound processor, (ESP).

To create new and view active Timers, select **Timers** from the **Window** menu.

Timer programming is accomplished using drag and drop. Individual signal processing objects, object properties or Parameter Sets may be dragged to a specific Timer. When the Timer is invoked, or recalled, the state of the object at the time of programming will be restored.
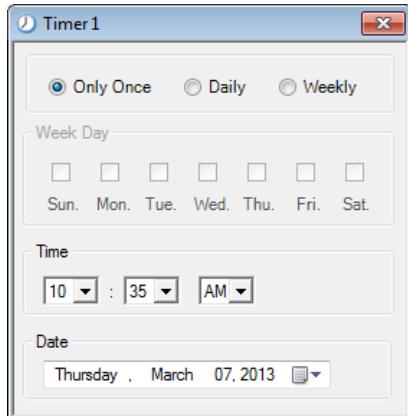
From within the Timers window the following functions are available:

Recall Timer – Selecting this item recalls the settings associated with the Timer.

View Timer – Select the desired Timer name to view the signal processing devices or Parameter Sets associated with the Timer. Double click on the top level of a Timers tree view to display the Timer Settings for this timer.

Edit Timer – expand the tree view of the selected Timer to view and edit its settings.

When an object is initially dragged and dropped on a Timer the Timer Settings window appears. This displays the time and recurrence settings for the individual Timer:

Recurrence – Determines the frequency of the Timer. Available options are Only Once, Daily or Weekly.

Week Day – Determines the frequency of the timer. This option is only available when the Recurrence is set to Weekly.
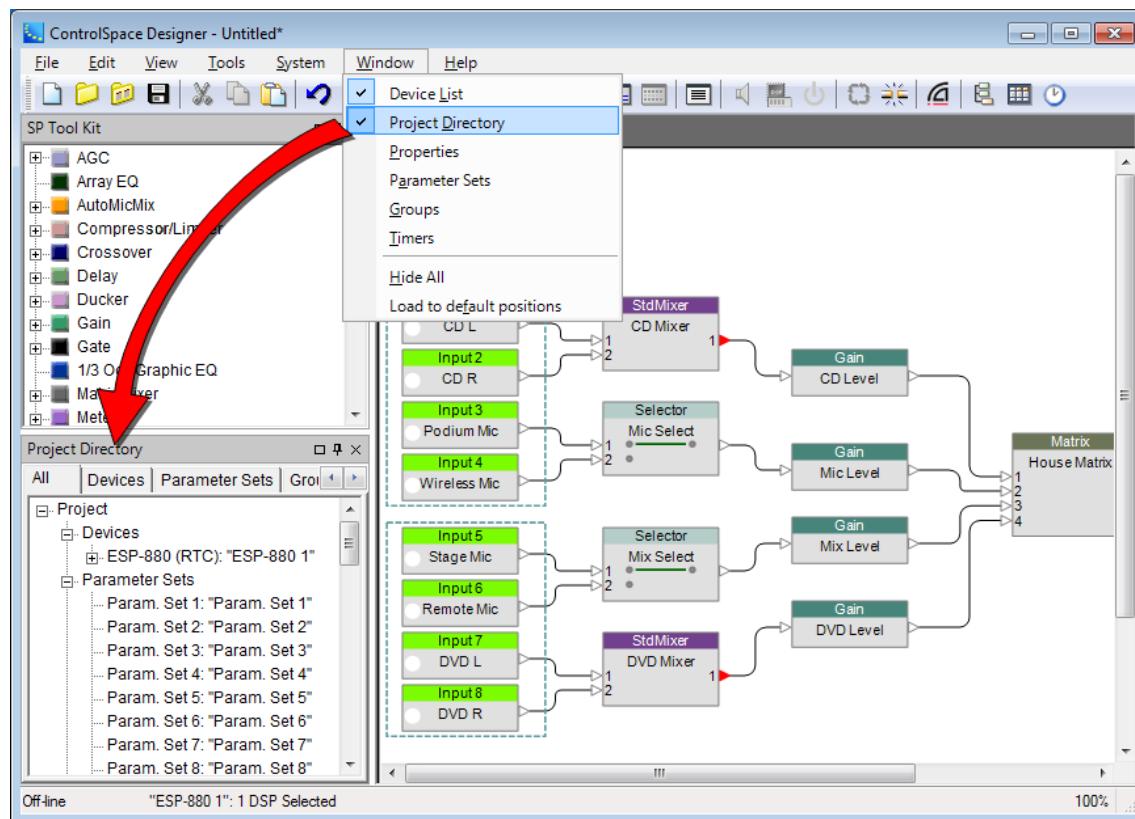
Time – displays the time of day the timer will be invoked.

Date – displays the date the timer will occur. This option is only available when the Recurrence is set to Only Once.

Project Directory
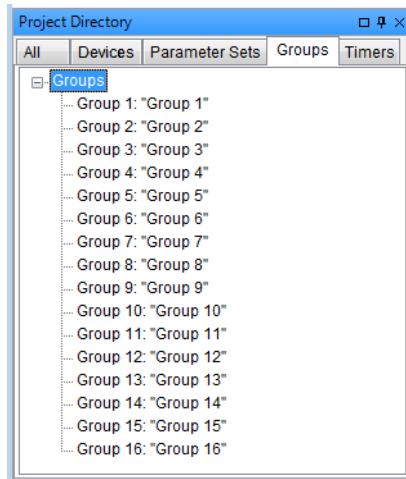
An advanced method to program a system is to use the Project Directory. The Project Directory is the master directory of all components, signal processing objects, and control functions in the system design. Visibility to all devices, signal processing blocks, inputs, outputs, control centers, and programming functions is provided in this single location.

To access the Project Directory, select **Project Directory** from the **Window** menu.
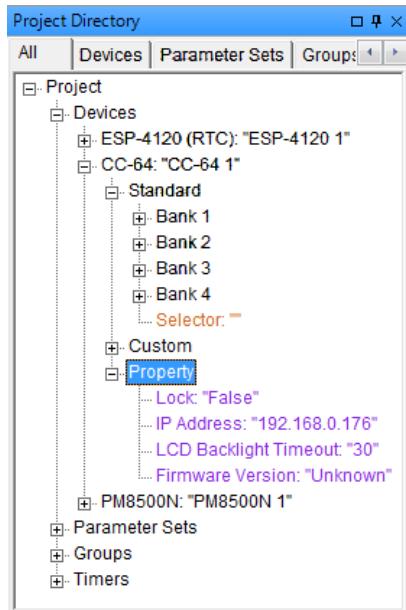
The Project Directory Window

Use the tabs at the top of the project directory window to select a sub category of objects in your design. By default, the *All* tab is selected at the top of the project directory window to display all objects in your design. You may select different tabs to isolate sub categories of objects. For example, select the Groups tab to view all defined Groups in a design.
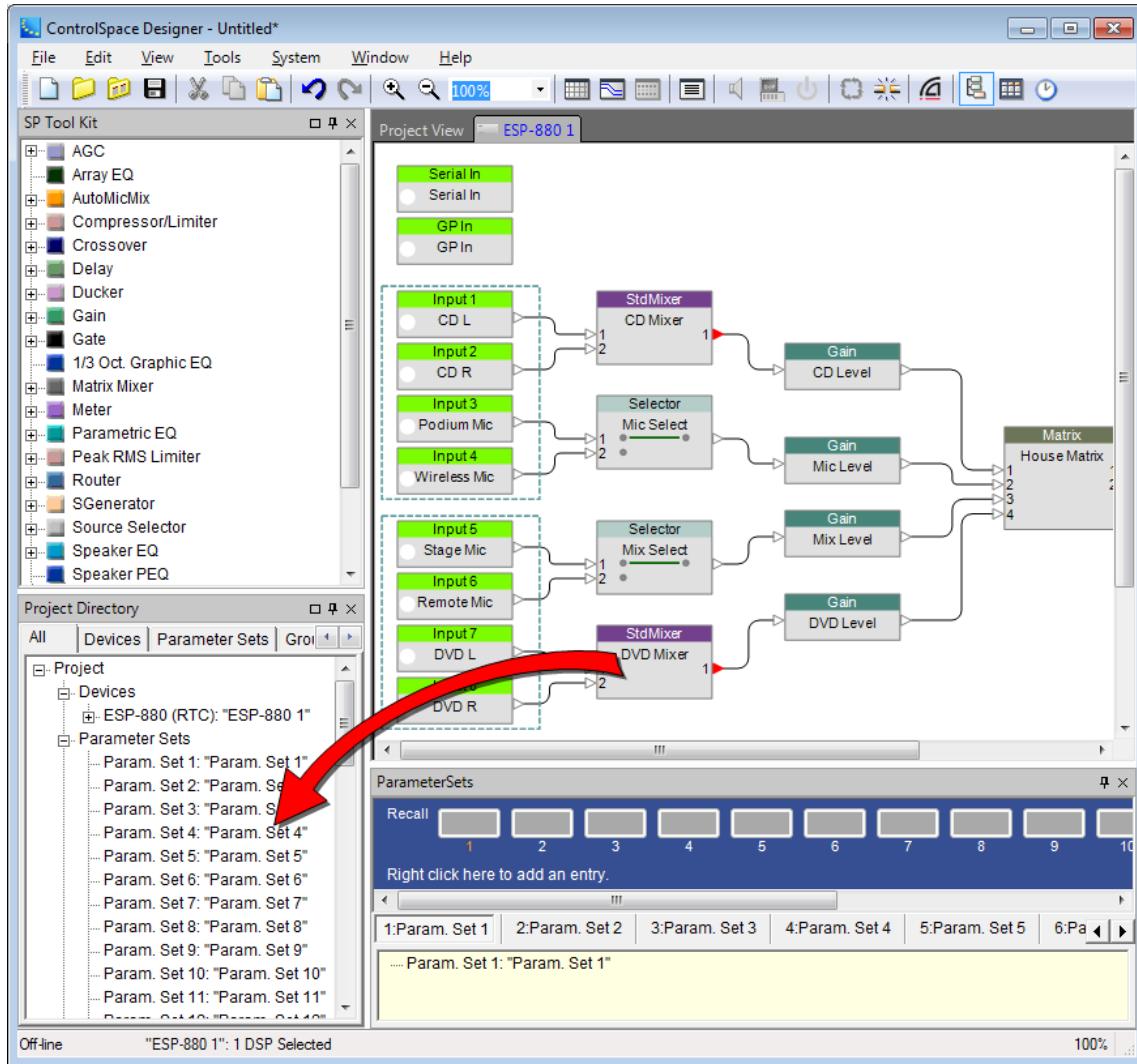
Groups Tab of the Project Directory

The project directory window contains all objects in your system design and displays them in a tree structure. To see a particular object in your design, expand this tree structure until you reach the settings of interest. For example, to view the IP Address of a CC-64 Control Center, expand the directory to Project > Devices > CC-64 > Property.
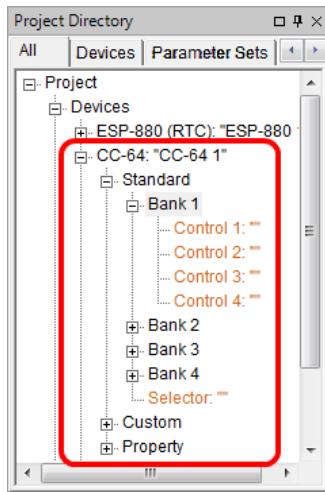
Project Directory Tree Expanded

You may program parameter sets, groups, and timers by dragging and dropping signal processing blocks from ESP View into Project Directory locations. For example, to program a parameter set, select signal processing blocks and drag those into the parameter set tree structure.
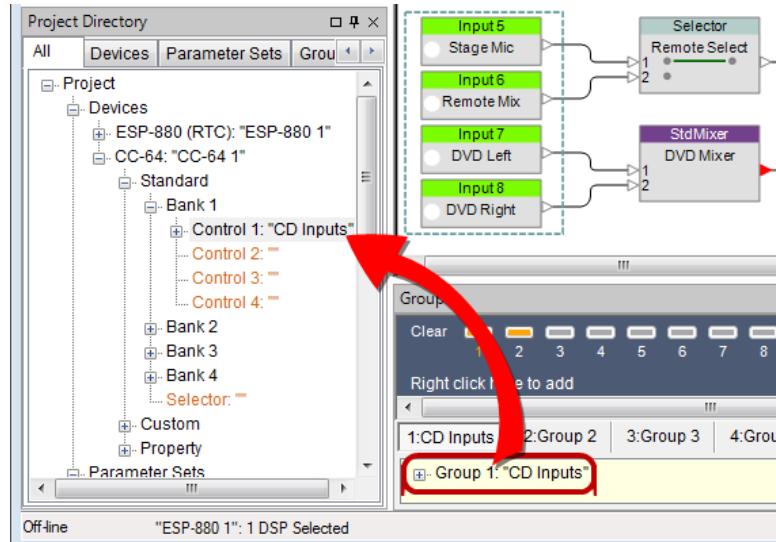
Drag and Drop Processing Blocks into the Project Directory

You may also use the Project Directory to program user controls without opening the Smart Simulators or GPI control panels. For example, to access the CC-64 controls, select the Devices tab in the Project Directory window, then click on the CC-64 > Standard.
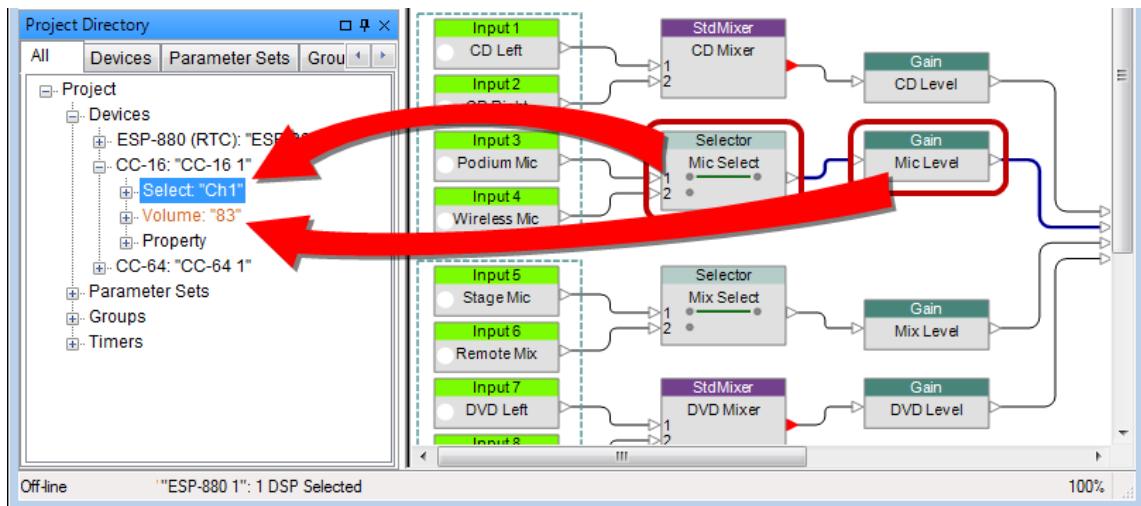
Accessing CC-64 controls in the Project Directory

Once the Project Directory window is open, you may drag and drop into the banked controls, Selector, and Custom controls just as you would with the CC-64 Smart Simulator.
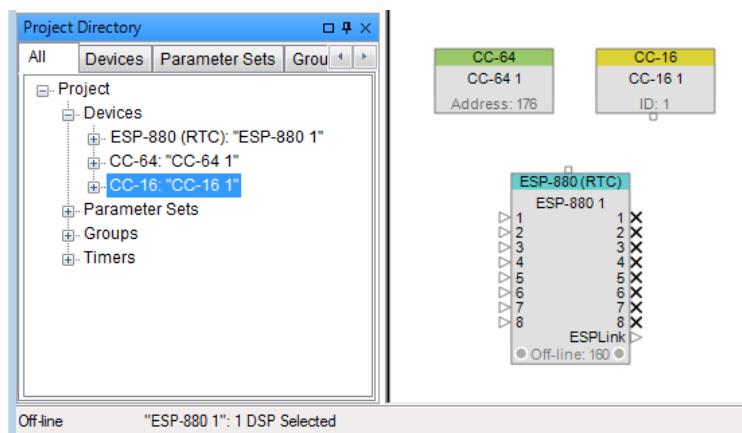
Assigning Groups to CC-64 using the Project Directory

In the same manner, you may directly assign selector and gain functions to CC-16 controls using the Project Directory window.
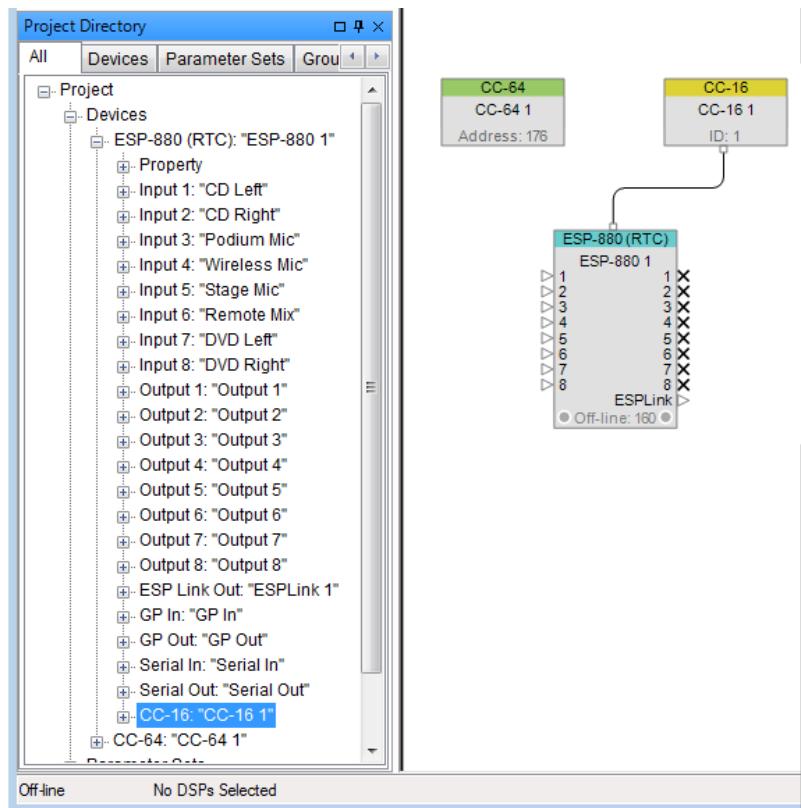
Assigning Blocks to CC-16 using the Project Directory

NOTE: The position of CC-16 Zone Controller in the Project Directory is dependent on the ESP to which it is connected. Before a wiring connection is made from a CC-16 to its associated ESP in the Project View, it appears in the top level of the Devices tree. After a wiring connection is made to an ESP, each CC-16 appears within its associated ESP tree structure.

CC-16 "Unconnected" Position within the Project Directory
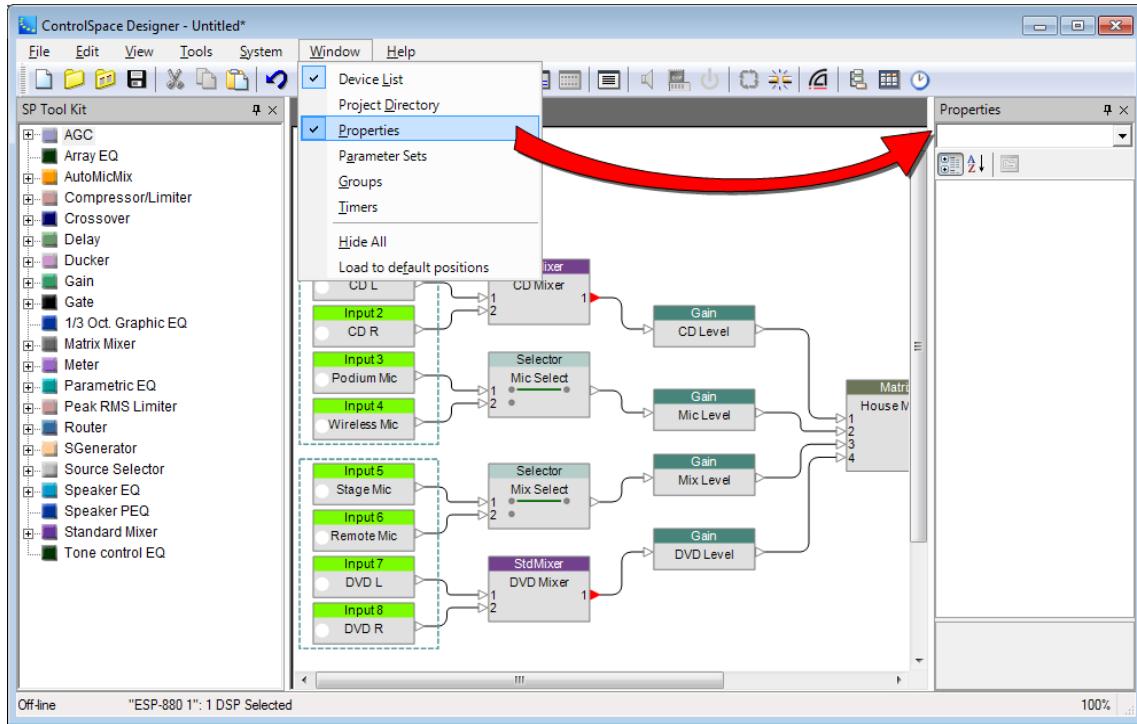
CC-16 "Connected" Position within the Project Directory

Properties Window

The Properties window allows you to view and update settings for a selected object without opening its control panel. Open the Properties window by selecting **Properties** from the **Window** menu.

Properties Window

Once the Properties Window is open, select an object in Project or ESP Views to see all its properties. You may also use the drop-down menu at the top of the Properties window to select a different device.

Viewing Selected Device Properties *Selecting a Different Device*
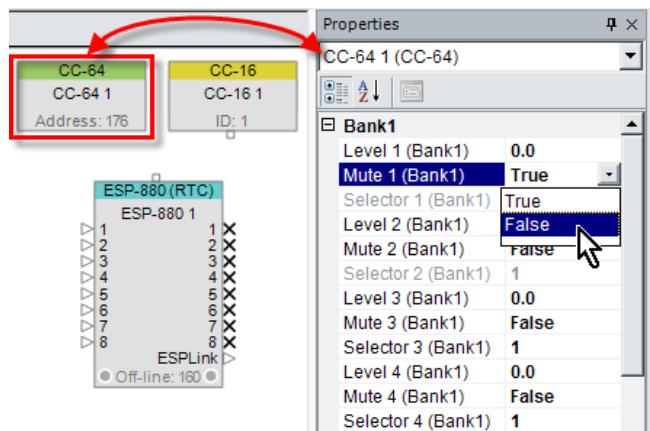
The Properties window may be used to change card assignments or any other setting for an ESP within Project View. Select the ESP icon, and then choose a new card for the desired slot in the Properties window.
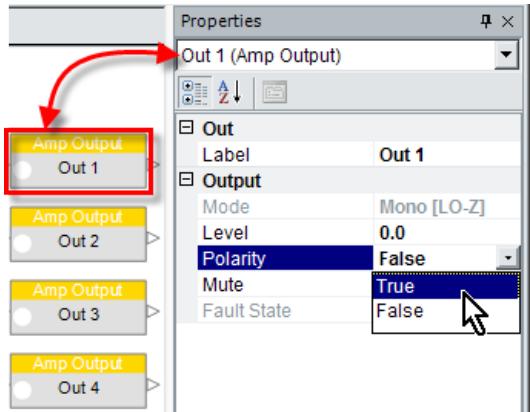
Adjusting ESP Card Assignments in the Properties Window

You may also adjust control panel settings using the Properties Window. Select the desired control panel to view or change its properties within the Properties Window.

Adjust CC-64 Settings within the Properties Window

Processing blocks within Project, ESP, or PowerMatch views are equally accessible using the Properties Window. Simply select the desired object to view or change its properties within the Properties Window.
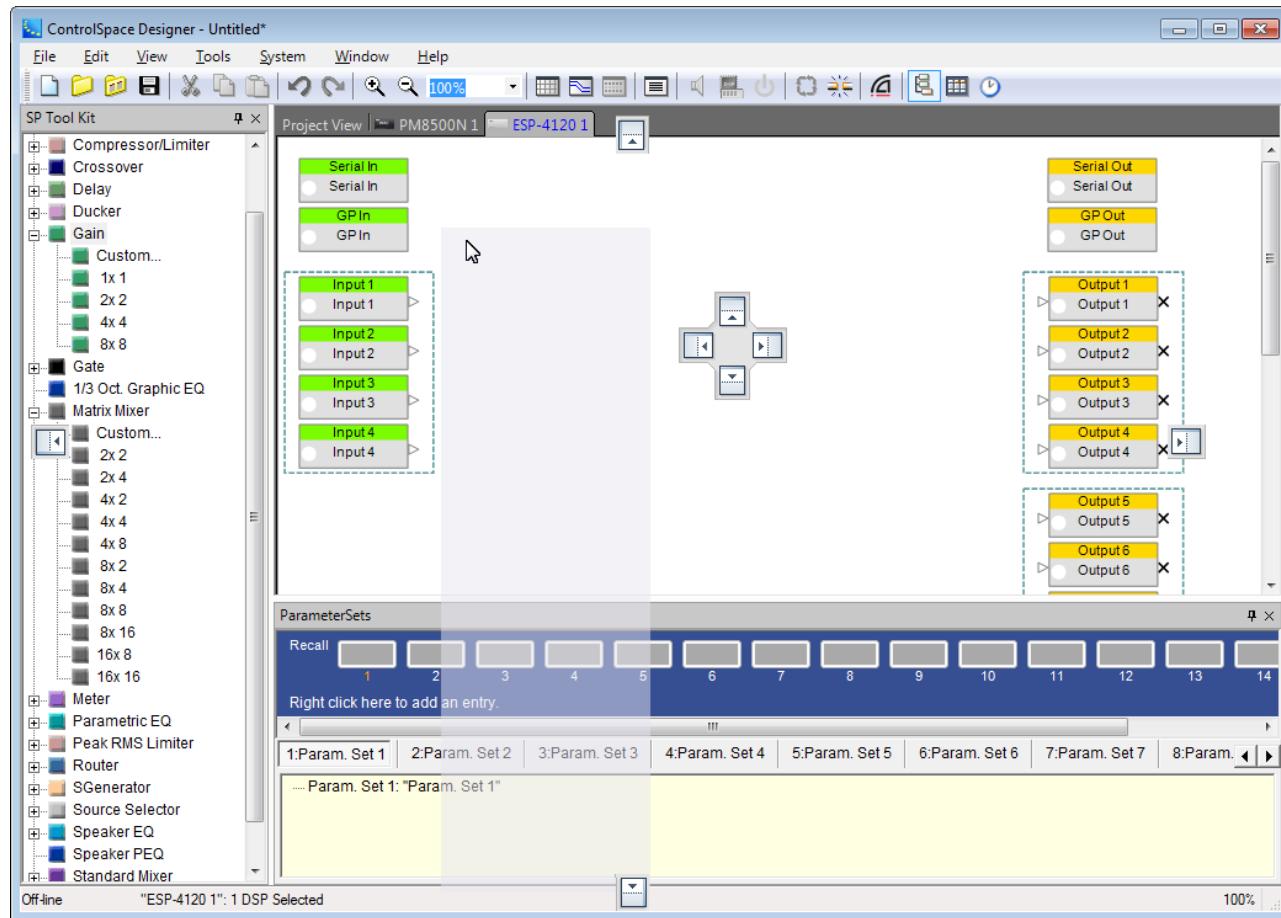
Adjust PowerMatch Settings within the Properties Window

Window Controls

All major windows within the ControlSpace® Designer™ interface may be configured as either floating, docked, or docked, but minimized. By default, windows, when made active, are docked.
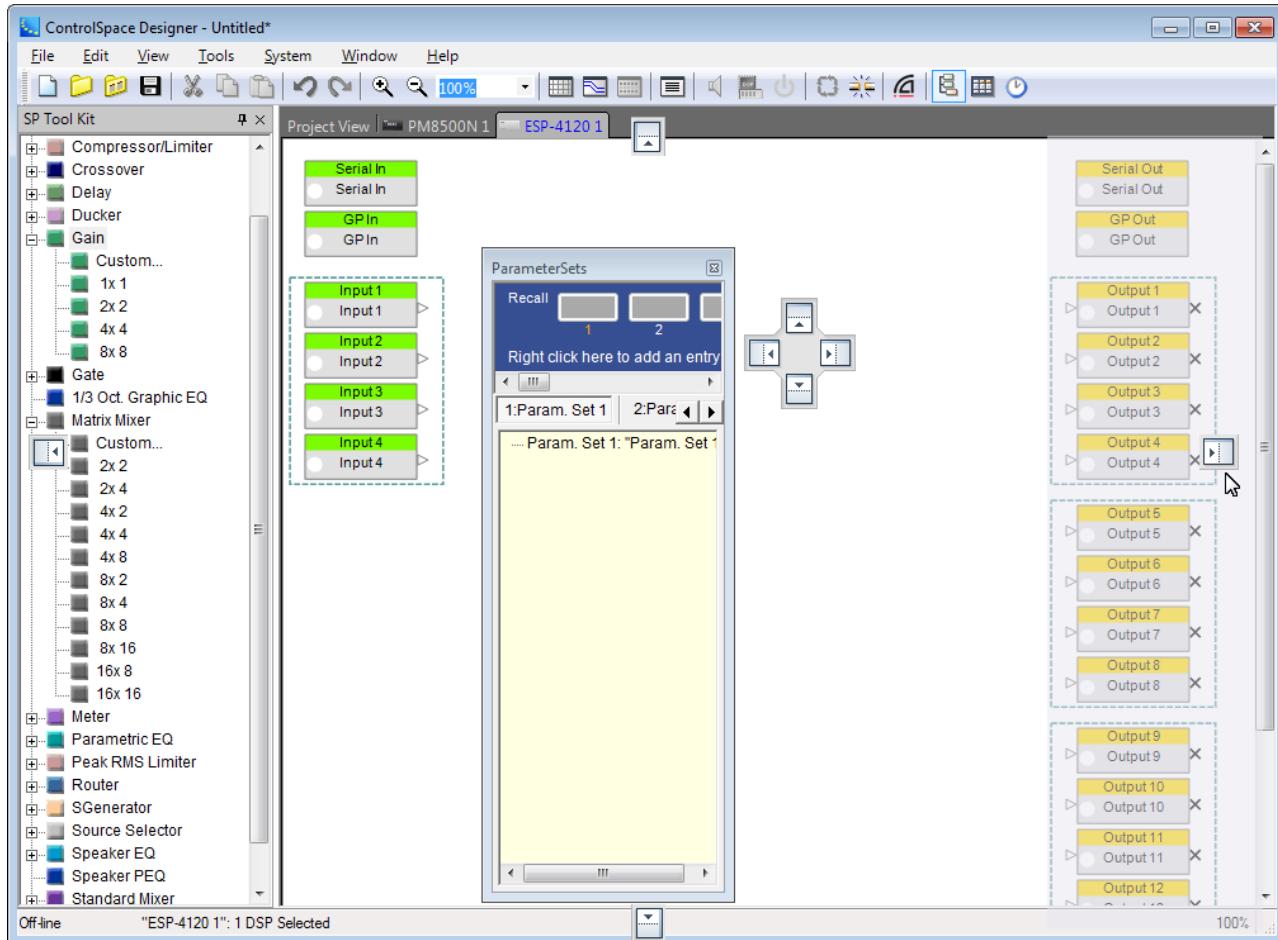
Floating Windows

To float a window within the application, simply click on the title bar and drag the window to another location within the application. Windows, when floated, may be placed anywhere on the monitor area.
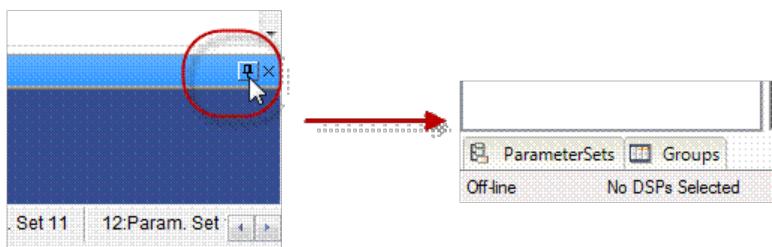
Docking Windows

Windows may be docked anywhere along the edges of the main application window. To dock a floating window drag and drop the window on any of the docking targets along the edge of the application window.

Minimizing Docked Windows

A docked window may be minimized using the Pin tool located in the upper right section of the window's title bar. When selected the window is minimized to a tab along the edge of the application window.
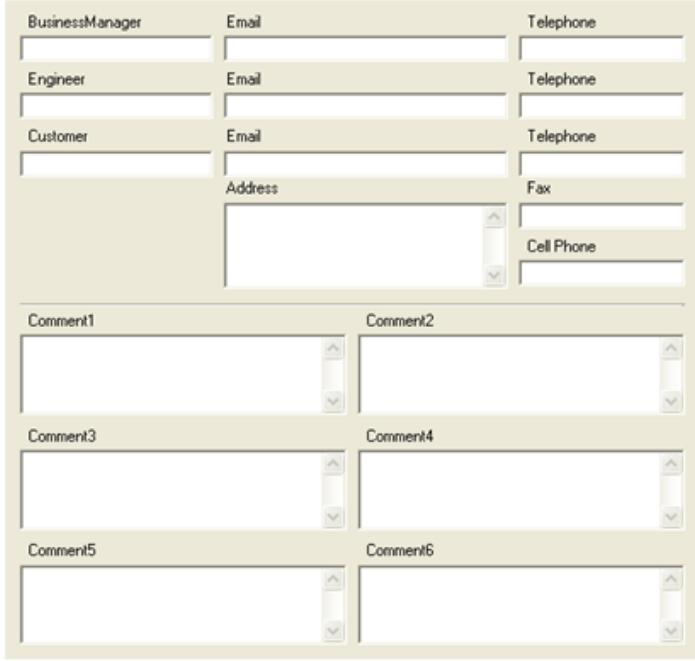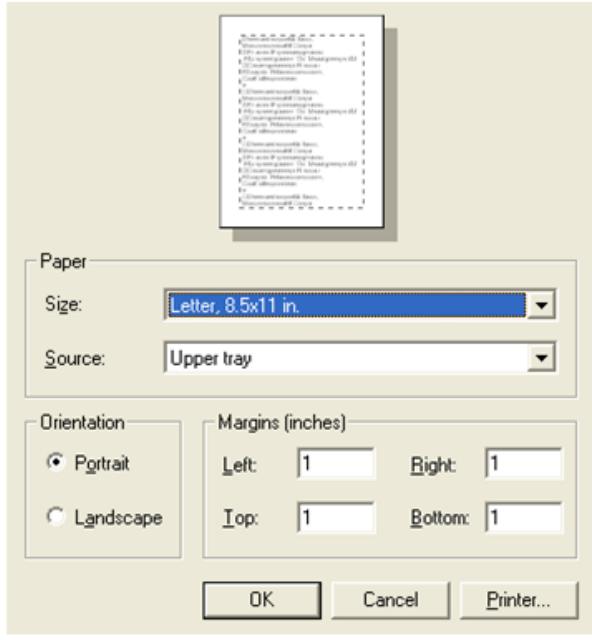
When minimized, selecting the tab will cause the window to be temporarily maximized.
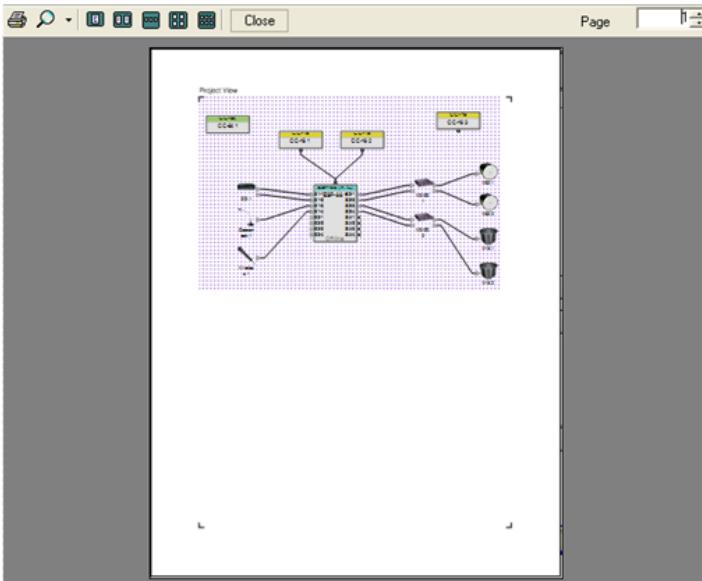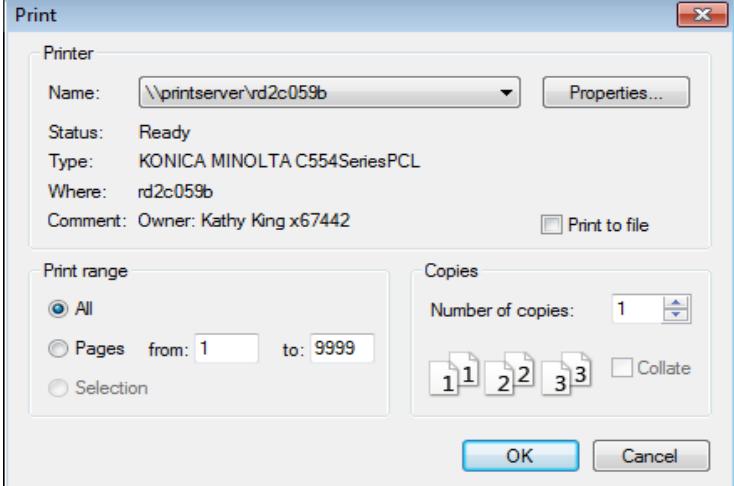
Menus Reference

File menu
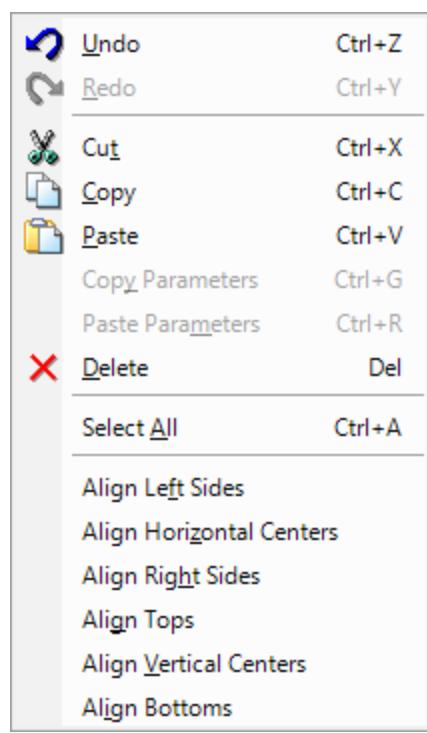
Function	Description
New	Creates a new project file (.csp). If a project is currently open and unsaved, you will be prompted to save it before creating a new project.
Open	Opens an existing project by locating it on the hard drive and choosing the .csp file. If a project is currently open with unsaved changes, you will be prompted to save it before opening a new project.
Merge Projects	Allows you to open a project file and merge it with the currently open project file.
Save	Saves changes to the project. If you have not yet saved the project, you will be prompted to name and save the project.
Save As	Creates a copy of the project and saves it with a different name. The new saved project will remain open and the original project will be closed.
Export	Exports the contents of your project to a comma delimited (.csv) file. This file contains the entire tree structure of your project, similar to the Project Directory window.

Function	Description
Project Information	 Opens the **Project Information** window, where you can record contact information and comments related to the design.
Page Setup	 Opens the **Page Setup** window, where you can change the Paper Size, printer paper source, orientation, and margin sizes.

Function	Description
Print Preview	 Opens the **Print Preview** window to view what your design will look like when printed.
Print	 Opens the **Print** window to select a printer, and specify which pages to print, and number of copies.
Recent Files	Lists the four most recently active projects. Select one to open the project file.
Exit	Closes ControlSpace Designer software. If a .csp file is open you will be prompted to save changes.

Edit menu

Undo	Ctrl+Z
Redo	Ctrl+Y
Cut	Ctrl+X
Copy	Ctrl+C
Paste	Ctrl+V
Copy Parameters	Ctrl+G
Paste Parameters	Ctrl+R
Delete	Del
Select All	Ctrl+A
Align Left Sides	
Align Horizontal Centers	
Align Right Sides	
Align Tops	
Align Vertical Centers	
Align Bottoms	
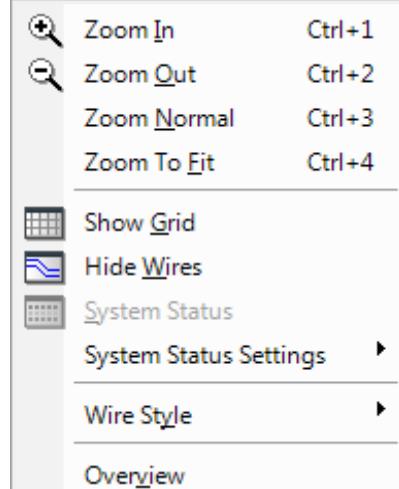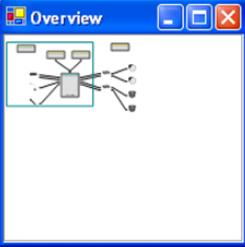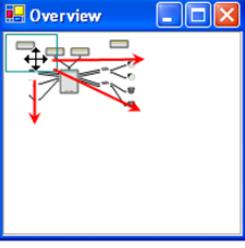
Function	Description
Undo	Undo your last action or undo multiple actions for each Project View Tab.
Redo	Redo your last action (after undo) or redo multiple undo actions up to the most recent action within the selected Project View Tab.
Cut	Deletes the selected item and copies it to the clipboard (standard Windows editing function).
Copy	Copies the item to the clipboard (standard Windows editing function).
Paste	Pastes the contents of the clipboard (standard Windows editing function).
Copy Para-meters	Copies the parameters, or settings, for a signal processing block in the Signal Processing View. The parameters can be copied to another signal processing block of the same type.
Paste Para-meters	Pastes the copied settings from one signal processing block to one or more other blocks of the same type.
Delete	Deletes the selected item.
Select All	Selects all items in the active window.

Function	Description
Align Left Sides	Aligns the left sides of all selected signal processing blocks in **Project View** or the Signal Processing View.
Align Horizontal Centers	Aligns the horizontal centers of all selected signal processing blocks in **Project View** or the Signal Processing View.
Align Right Sides	Aligns the right sides of all selected signal processing blocks in **Project View** or the Signal Processing View.
Align Tops	Aligns the tops of all selected signal processing blocks in **Project View** or the Signal Processing View.
Align Vertical Centers	Aligns the vertical centers of all selected signal processing blocks in **Project View** or the Signal Processing View.
Align Bottoms	Aligns the bottoms of all selected signal processing blocks in **Project View** or the Signal Processing View.
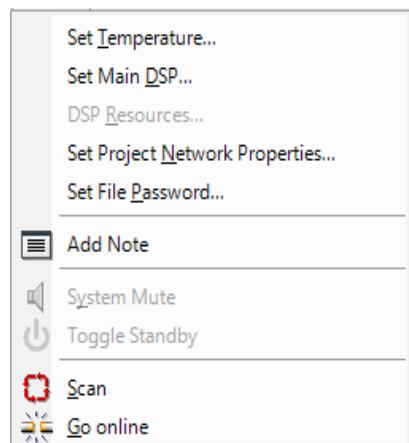
View menu
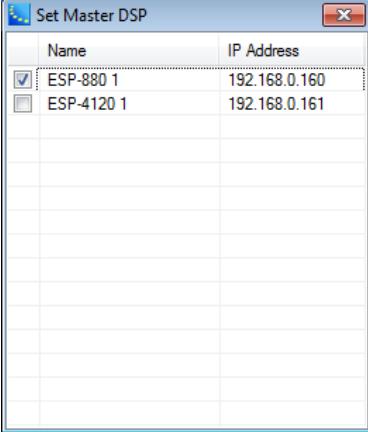
Function	Description
Zoom In	Magnifies your view in the **Design Workspace**.
Zoom Out	Displays a larger area of the **Design Workspace**.

Function	Description
Zoom Normal	Sets the zoom level to 100%.
Zoom To Fit	Sets the zoom level so that all objects can be seen in **Project View**, or the Signal Processing View.
Show Grid	Switches the background grid in **Project View**, or the Signal Processing View window between two different patterns, or no grid.
Hidden Wires mode	Toggles the wiring between show and hide.
System Status	Displays the monitor panels for all PowerMatch amplifiers.
System Status Settings	Displays the default settings for how monitor panels appear within the application. Select AutoTile to toggle the auto tiling function on and off. Select Collapsed View to toggle the initial display state of all PowerMatch amplifier monitor panels between collapsed and expanded.
Wire Style	Selects Line, Orthogonal, or Bezier style of wiring.
Overview	Opens the **Overview** window. The **Overview** window contains a high level view of your signal processing design in the Signal Processing View. Use your mouse cursor to draw a box around an area of your design that you would like to zoom in on. Use the mouse to drag the zoom window around your design. The overview window can be kept open while making changes to your designs.

Tools menu
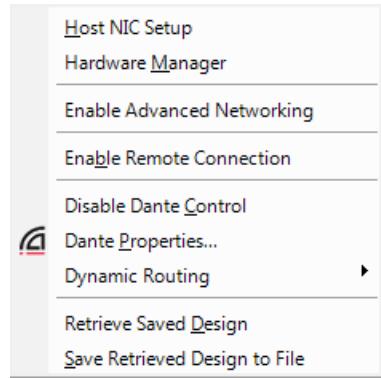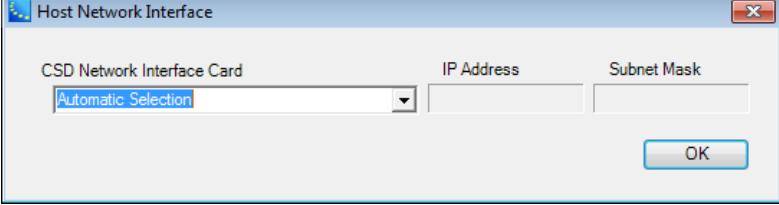
Function	Description
Set Tem- perature	Opens the **Temperature** window to set the ambient temperature for which you would like to calculate delay times, in degrees Fahrenheit, or degrees Celsius. Alternately you can set the speed of sound at your design location in ft/s or m/s. ControlSpace Designer software uses this value to calculate delay times when entered into a delay signal processing block. **Note: This setting does not change or modify any existing delay settings.**
Set Main DSP	Opens the Set Main DSP window. In a design with multiple devices, use this window to specify which device is the Real Time Clock (RTC) for your system. Only one device can act as the RTC.
DSP	Opens the DSP Resources window to view the processing and delay memory usage for the selec-
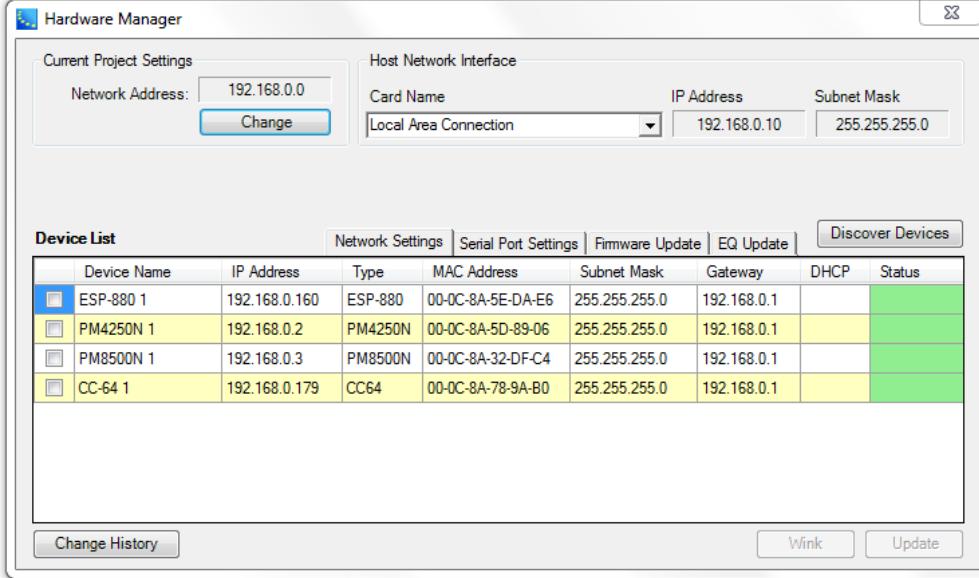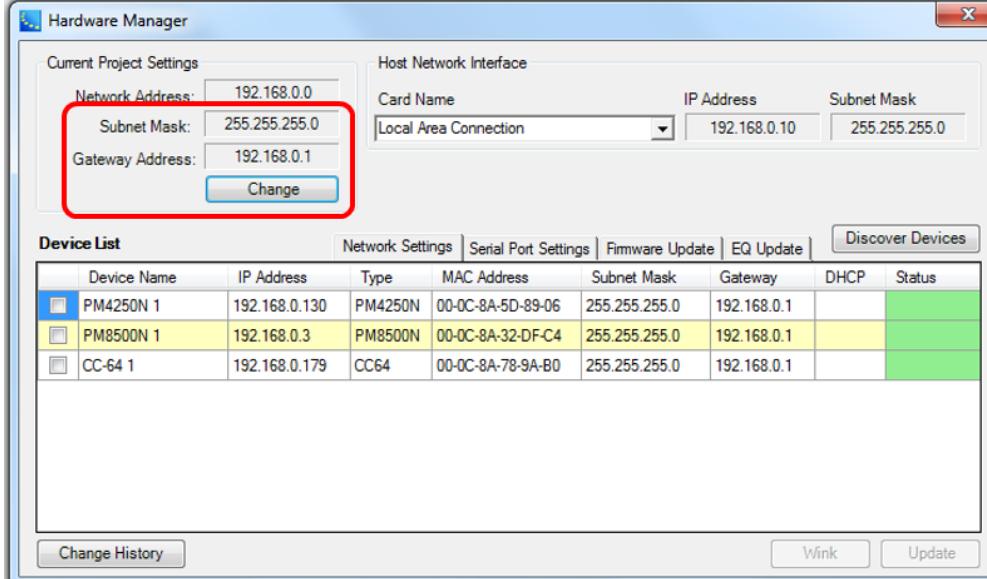
Function	Description
Resources	ted ESP. **[ESP-4120 1] DSP Resources** DSP Usage : 5% Delay Usage : 0%
Set Project Address	Displays the Project Network Address dialog. Allows you to define a new default network and subnet. All devices added to the Project View use the stored network address. **Set Project Network Address** Stored Project Network Address 192 . 168 . 0 . 0 New Project Network Address ___ . ___ . ___ . 0 ☐ Use as default for New Projects Change Cancel
Set File Pass-word	The ControlSpace project file may be password protected to prevent modification. Once the project file is protected, all subsequent connections to the system via ControlSpace Designer will require the entry of the password before the connection is established. **File Password Setting** New Password : _____ Confirm : _____ OK Cancel
Add Note	Adds a text frame to the Project View or Device View for placing labels or notes on your design.
System Mute	Mutes all audio output when working online.
Toggle Standby	Places a connected device into or out of Standby. Only works with devices which support a standby mode.
Scan	Detects hardware on your local network. When ControlSpace Designer software completes the scan, the **Project View** is automatically populated with the hardware devices that are properly connected in your local network. Do not use **Scan** while an existing project is open. This may result in a conflict that can cause a change in your system design configuration. Scan should be used only with a blank new project, as a means to identify what hardware exists on the local network.
Go online/	Connects/disconnects a device. When connected to the ControlSpace hardware, click **Go online**
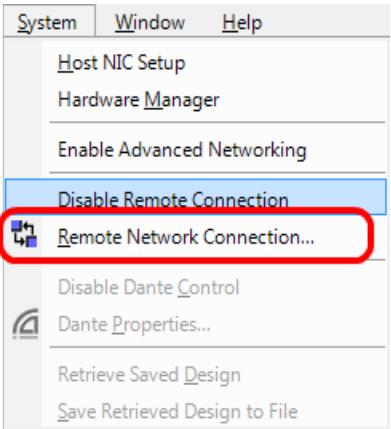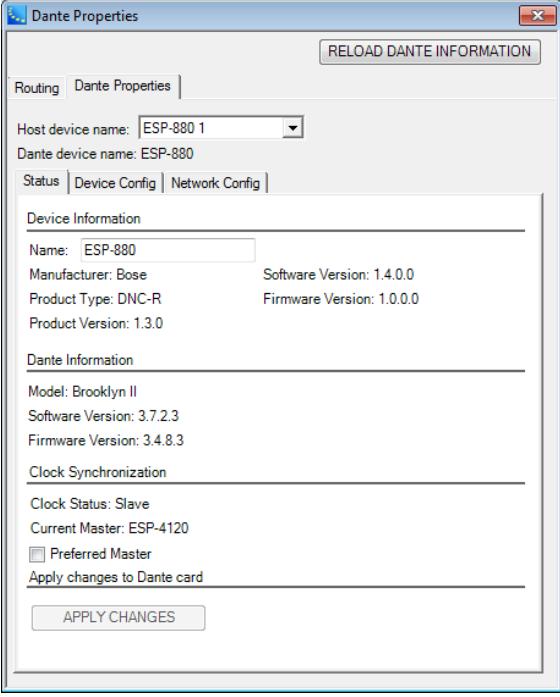
Function	Description
Go offline	to upload your system design, or download it from the hardware, and to adjust settings in real time.
	The background in **Project View**, and the Signal Processing View turn blue to indicate that you are now working online.
	When you are online, click **Go offline** to disconnect.

System menu
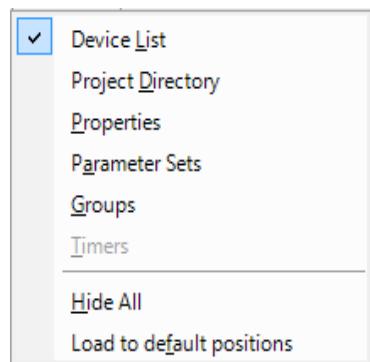
Function	Description
Host NIC Setup	Opens the **Host Network Interface** window.
Hardware Manager	Opens the **Hardware Manager** window.

Function	Description
Enable/Disable Advanced Networking	Selecting **Enable Advanced Networking** makes mask and gateway properties of networked devices appear in the Hardware Manager dialog, allowing you to support variable subnets.
Enable/Disable Remote Connection	Allows you to make a remote network connection. Clicking **Enable Remote Connection** adds **Remote Network Connection** to the menu. Clicking this item opens a dialog for establishing connections to remote devices.

Function	Description
	System Window Help Host NIC Setup Hardware Manager Enable Advanced Networking Disable Remote Connection Remote Network Connection... Disable Dante Control Dante Properties... Retrieve Saved Design Save Retrieved Design to File
Disable/Enable Dante™ Control	Disable/Enable control of the Dante network using ControlSpace Designer software so that another software application, such as Dante Controller, can be used without interference. When disabled, Dante Properties are inaccessible.
Dante Properties	Opens the **Dante Properties** Window.
Dynamic Routing	Enables/disables Dante Dynamic Routing. Update All Power On Subscriptions.
Retrieve Saved	Retrieves the project file without establishing a network connection to the

Function	Description
Design	system. Note that you must have an active network connection to enable this function. For additional information on when and how to use this function, see Retrieving_System_Configurations.htm in the Maintaining Your System section.
Save Retrieved Design to File	Retrieves the project file without establishing a network connection to the system, and immediately saves it as a file. Note that you must have an active network connection to enable this function. For additional information on when and how to use this function, see Retrieving_System_Configurations.htm in the Maintaining Your System section.
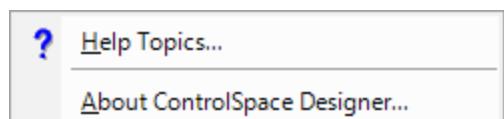
Window menu

Function	Description
Device List	Toggles the **Device List** window between show and hide. When working in the Project View, toggles the System Components, and when working in Signal Processing View, toggles the **SP Tool Kit** window between show and hide.
Project Directory	Toggles the **Project Directory** window between show and hide.
Properties	Toggles the **Properties** window between show and hide.
Parameter Sets	Toggles the **Parameter Sets** window between show and hide.
Groups	Toggles the **Groups** window between show and hide.
Timers	Toggles the **Timers** window between show and hide.
Hide All	Closes all windows except **Project View** and the Signal Processing

Function	Description
	View.
Load to default positions	Returns all open windows to their default location in ControlSpace Designer software.

Help menu

Function	Description
Help Topics	Opens the ControlSpace® Designer™ help.
About ControlSpace Designer	Opens the About ControlSpace Designer software window.

Connecting to Devices

Connection methods

The ControlSpace® Designer™ software supports three methods of connection to Bose system electronics and control devices:

- USB connection
- Direct Ethernet connection
- Networked Ethernet connection utilizing network switches or hubs

The connection method you use will vary based on the capabilities of the hardware device. The following table summarizes the supported connection methods for the Bose system electronics that are configured using the ControlSpace Designer software.

Connection Method vs. Device
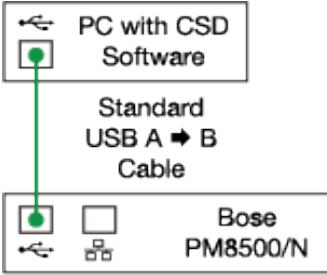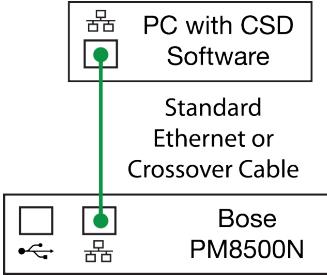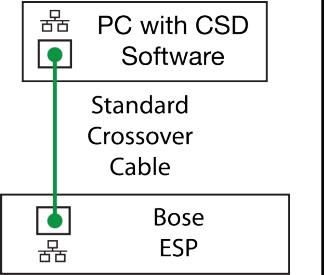
Device	USB Connection	Direct Ethernet Connection	Networked Ethernet Connection
PowerMatch USB-only amplifier	Yes	N/A	N/A
PowerMatch networked amplifier	Yes	Cat-5*	DHCP or Fixed IP
ESP-00 II/88	No	Cat-5	Fixed IP
ESP-880, ESP-1240, ESP-4120 or ESP-1600	No	Cat-5* (Cat-5e recommended)	DHCP or Fixed IP
CC-64	No	Cat-5	Fixed IP

Auto-MDIX devices resolve Tx/Rx pairs and support direct connections between a PC and the hardware using either standard or crossover Ethernet cables.

Cabling and PC configurations

Each of the connection methods described above uses a unique connection and PC configuration. When connecting to the hardware first determine the method of connection that will be used, and use the following reference information to determine the PC and hardware cabling, and communication settings.

Direct Connection Methods

USB	Ethernet Auto MDIX	Ethernet Crossover
⌁ PC with CSD Software Standard USB A ➡ B Cable Bose PM8500/N	PC with CSD Software Standard Ethernet or Crossover Cable Bose PM8500N	PC with CSD Software Standard Crossover Cable Bose ESP
• PC must support USB 1.0 or greater	• PC configured to use TC/IP networking • Set PC Network Address to 192.168.0.10 • PM8500N Default Address is 192.168.0.80	• PC configured to use TC/IP networking • Set PC Network Address to 192.168.0.10 • ESP Default Address is 192.168.0.160
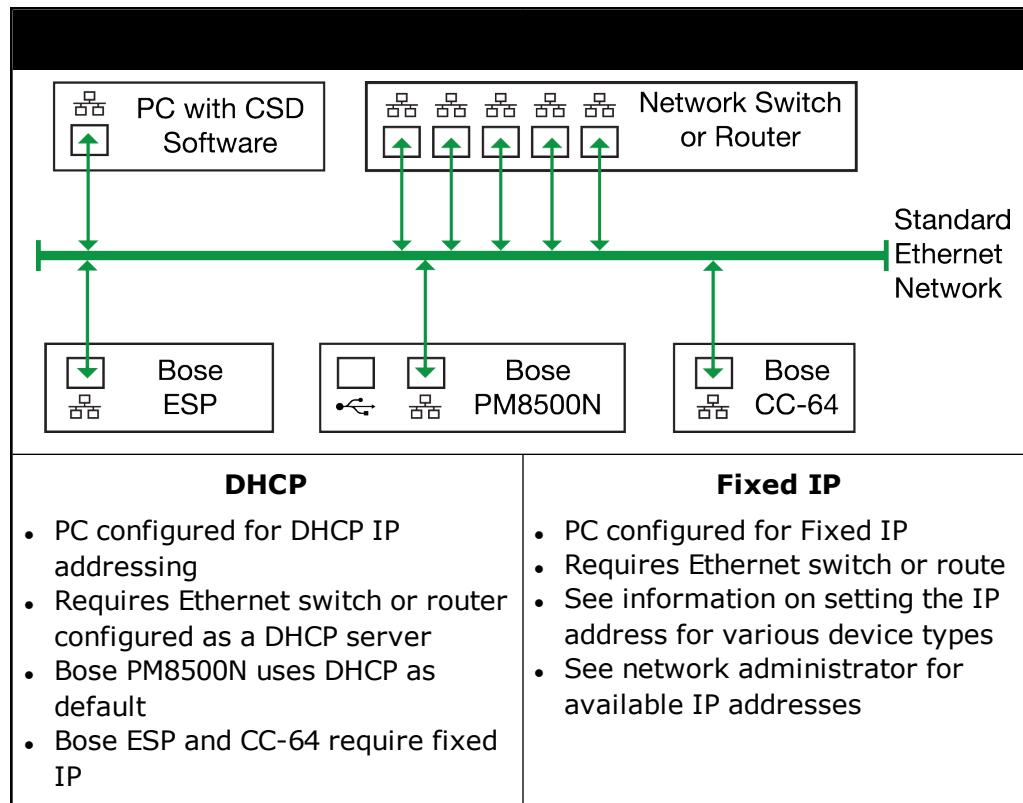
Adding devices to an existing network

Multiple devices can be configured for operation on an Ethernet network that utilizes network switches or routers to manage data communications between the devices. ControlSpace software is configured for operation within a single local area network (LAN) and is not designed for operation across multiple networks (i.e. communication via network gateways). In applications with large wide area networks, this requires creating a dedicated subnet for the various system processing, amplification, and control devices that will be installed.

NOTE: Bose system electronics are designed for installation on a private Ethernet network, and are not intended for a direct connection to the internet.

If you are adding your devices to an existing network, contact the network administrator for information about how the IP addresses are assigned for the network. Based on this information you will need to configure the devices for either DHCP or Fixed IP operation as shown below:

Ethernet Network Connection

	DHCP	Fixed IP
	• PC configured for DHCP IP addressing • Requires Ethernet switch or router configured as a DHCP server • Bose PM8500N uses DHCP as default • Bose ESP and CC-64 require fixed IP	• PC configured for Fixed IP • Requires Ethernet switch or route • See information on setting the IP address for various device types • See network administrator for available IP addresses
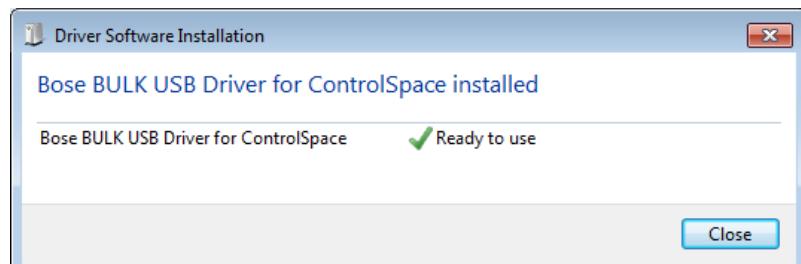
Using USB
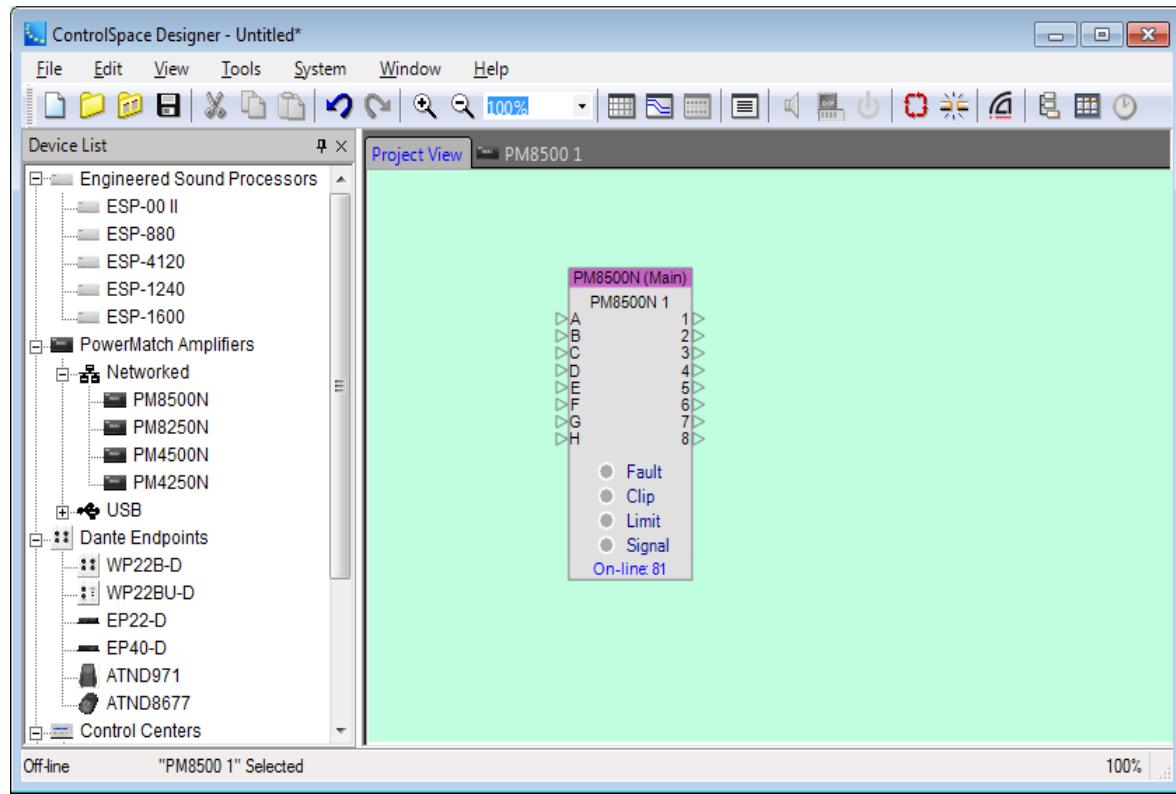
ControlSpace® Designer™ software supports the control of devices which are configured for USB control.

The first time a USB enabled hardware device is connected to the PC the BULK USB Driver is installed. Installation is confirmed by the following message:

Once this step is performed all subsequent connections via USB will occur automatically.

With the driver installed, launch the ControlSpace® Designer™ application. During the launch process the Power-Match® amplifier will be recognized and a new connection will be established.

The USB connection is indicated by the blue-green background color. At this point it is possible to modify the signal processing settings in real time.

For more information on connecting to and controlling devices via USB, see USB connection.

Direct Ethernet

Standard or crossover Ethernet cables can be used to directly connect your PC to the Bose device.

Auto-MDIX Ethernet ports

The Bose® PowerMatch® amplifiers use Auto-MDIX Ethernet ports that automatically correct for the cable type used for network connections. With this hardware, it is possible to use either a standard or crossover Ethernet cable and accomplish a direct connection between the PC and the hardware.

In this configuration, the only difference in the set up is that a standard Ethernet cable is used between the PC and the hardware, all other network configuration parameters are identical to those used for a direct connection with a crossover cable.

Ethernet cables

When connecting the PC directly to either a single ESP processor or PowerMatch amplifier, a standard or crossover Ethernet cable can be used. This connection does not require the use of a network management device, (switch, router or hub), but does require that you properly configure your PC for communication with the device.

Device connection status

Within the ControlSpace® Designer™ software the background color of the Project View, and title bar of devices within the Project View are used to indicate the current status of the device when a connection to the system is established.

Project and Signal Processing View Device Status

Connection Status	Background Color
Offline	White
USB connection established	Green
Ethernet connection established	Blue
Ethernet connection established, device offline	Gray (Signal Processing View only)
Connection established, device in standby	Yellow (Signal Processing View only)

NOTE: The background color of the Project View and Signal Processing View is gray when System Mute is engaged.

Project View Icon Device Status

Connection Status	Device Color
Offline	Default color
Connection established	Default color
Device offline	Gray
Device in standby	Yellow

Configuring Devices

Building a project file

The first step in creating a ControlSpace® system design is to specify the hardware components you intend to use. In ControlSpace® Designer™ software this is accomplished by launching the program and adding new devices to a project.
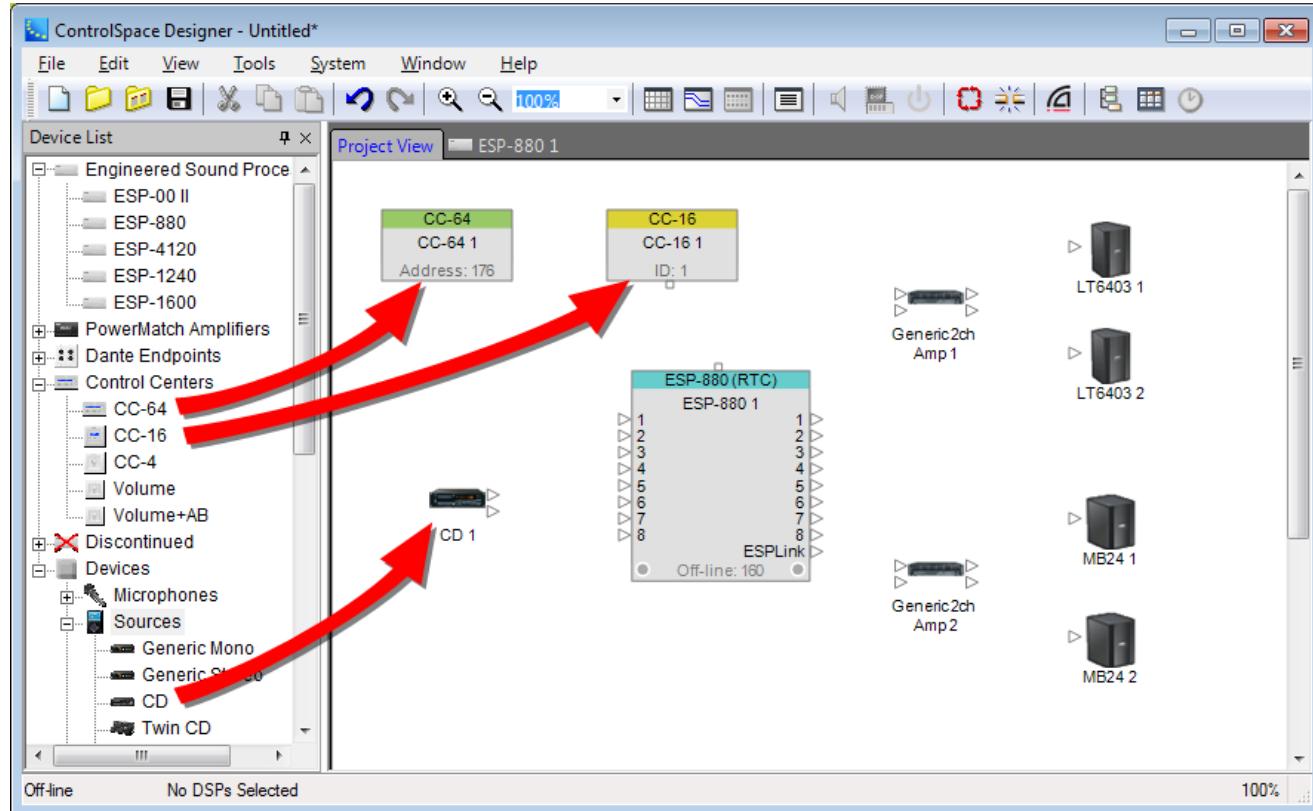
Project files

Each system design is stored in a file with a ".csp" file extension. When you launch ControlSpace Designer software, a new project is automatically created in temporary working memory and named "Untitled". You must save this information to disk to store the file for use in the event of a power loss. The first time you save a project, you are prompted to provide a name for it.

Note: The system configuration stored in a device can be downloaded to a project file at any time. This is helpful if you are working on a system that you did not create, or if you do not have the original .csp file.
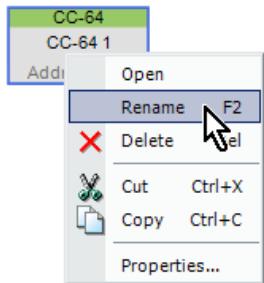
Adding Devices

Devices are added to your system design by dragging the device icons in the Device List on the left into the Project View on the right. The Project View is a workspace that allows you to graphically lay out the system design. In the following example, the ESP-880 and any CC-64s and CC-16s are part of the design. Although you can add other components, such as microphones and loudspeakers, they are for reference only and do not perform any function in ControlSpace® Designer™ software.
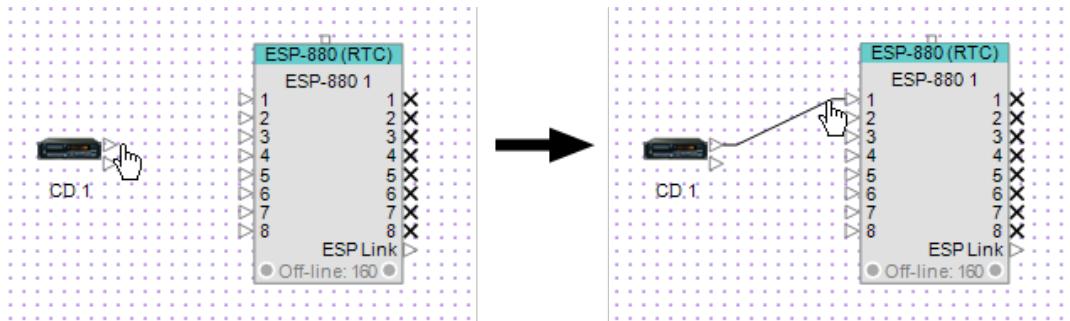
Dragging and Dropping devices into Project View

Any component in your design can be renamed. Select the icon and press **F2**, or right click and choose **Rename**.
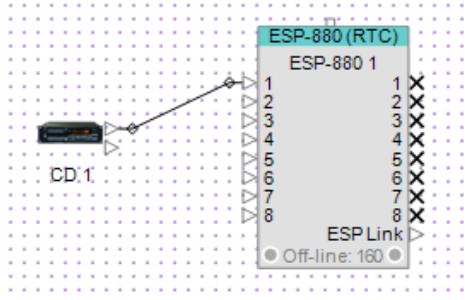
Renaming a component in Project View

Devices are wired together by dragging and dropping wires from output nodes to input nodes, as shown:
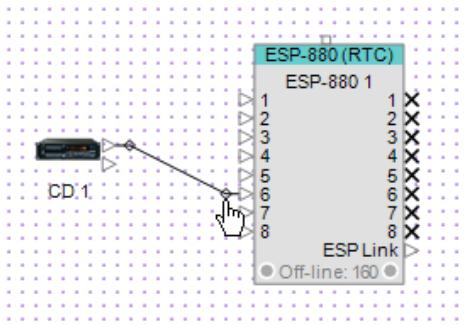
Clicking and dragging a wire from output to input.

To delete a wire, select the wire and press the **Delete** key.

Deleting a wire
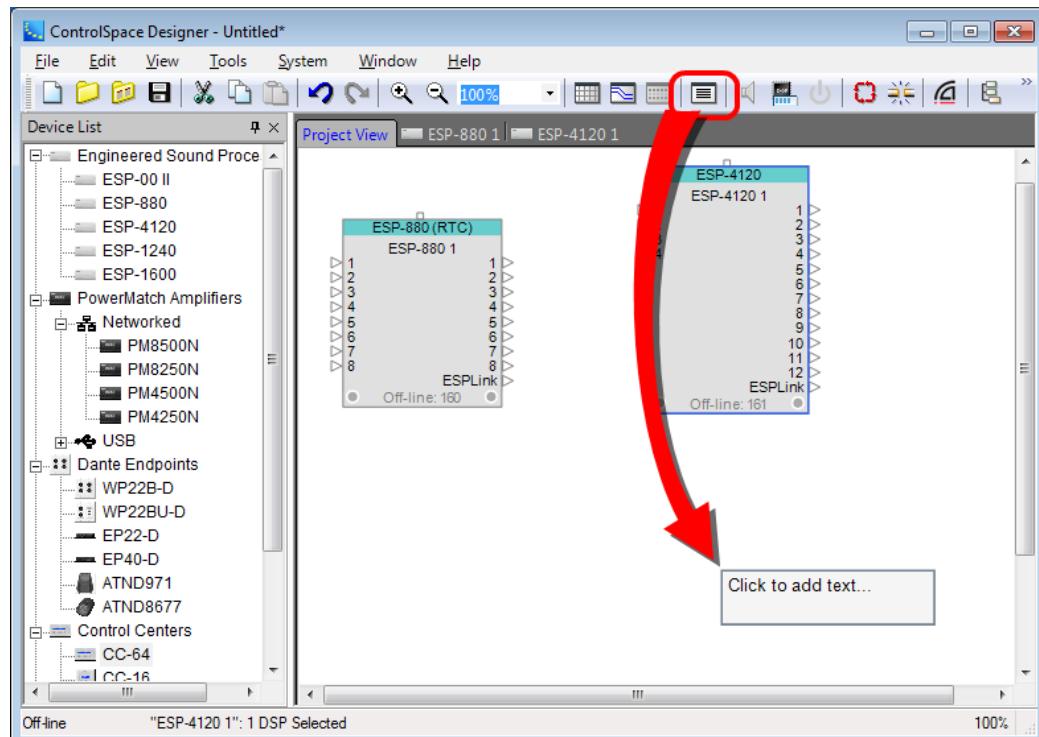
To move a wire, click anywhere on the wire to select it, then click and drag the node to the new location.
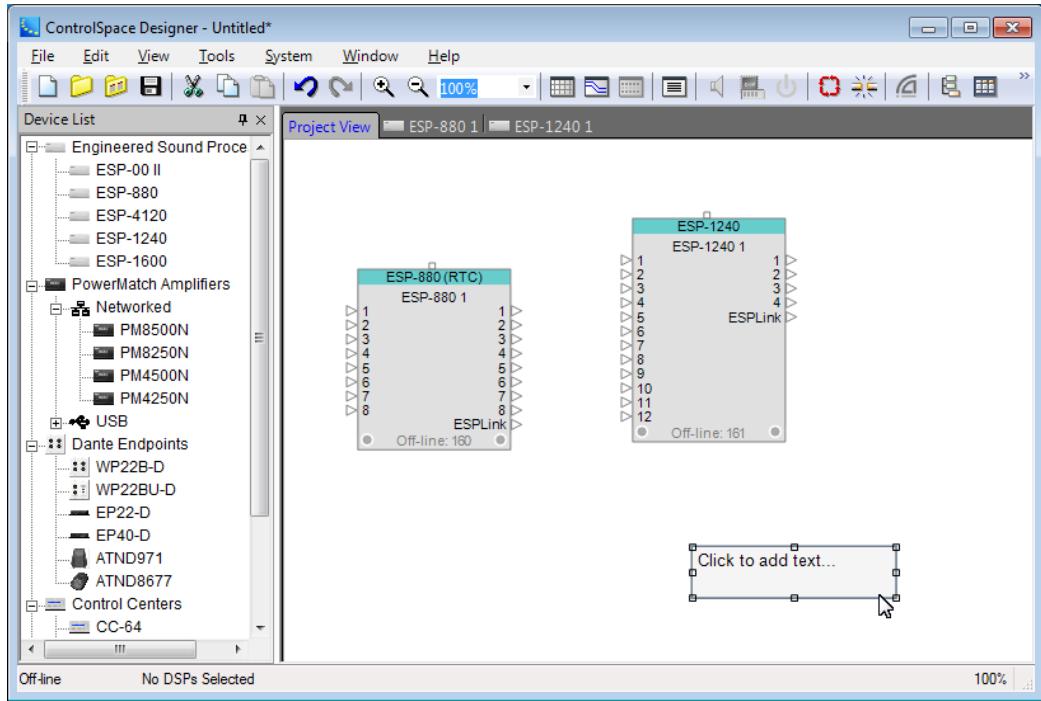
Dragging the blue node to move a wire

Adding Design Notes
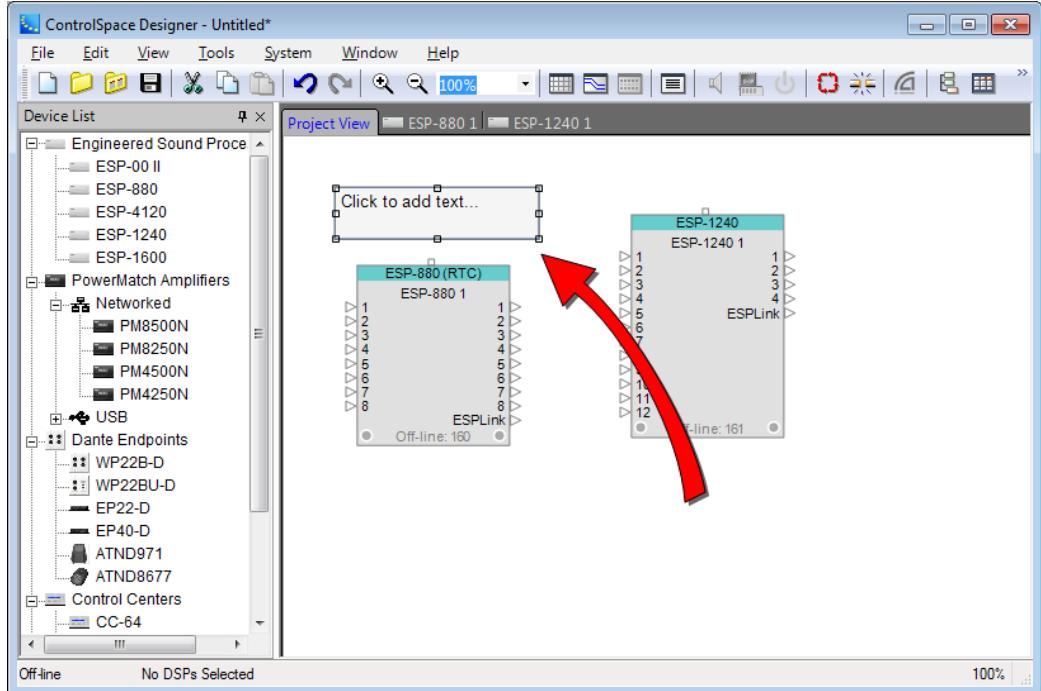
To add a note to your design, click the Add Note icon ▤ in the menu bar. This places a text frame in the design workspace.
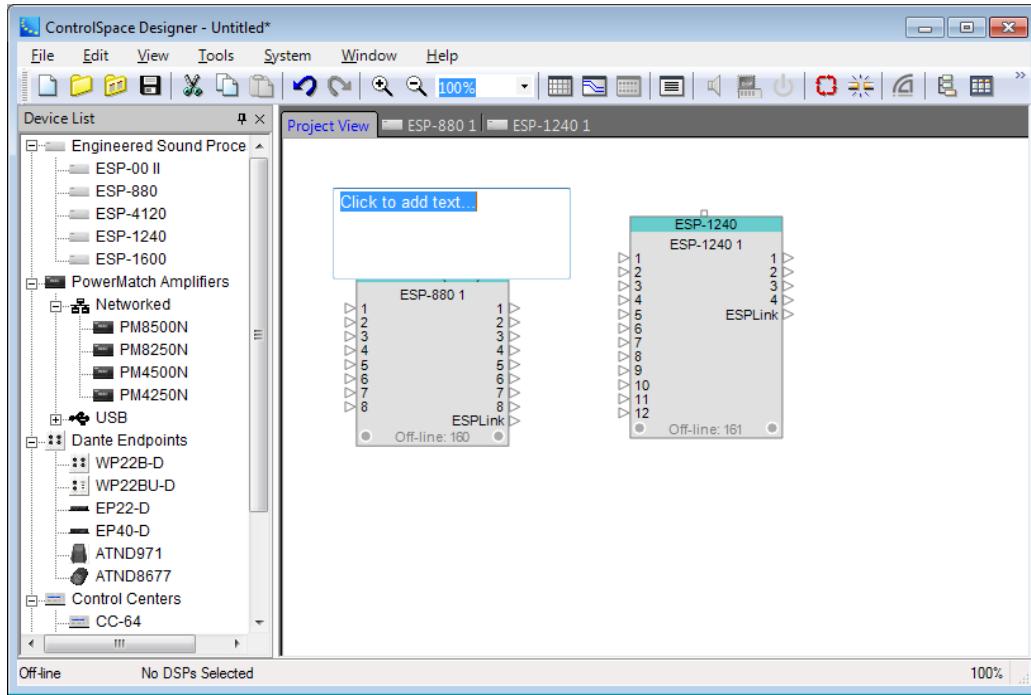
Click the text frame to select it. Notice the eight points on the border of the frame. You can click and drag any of these to re-size the text frame.
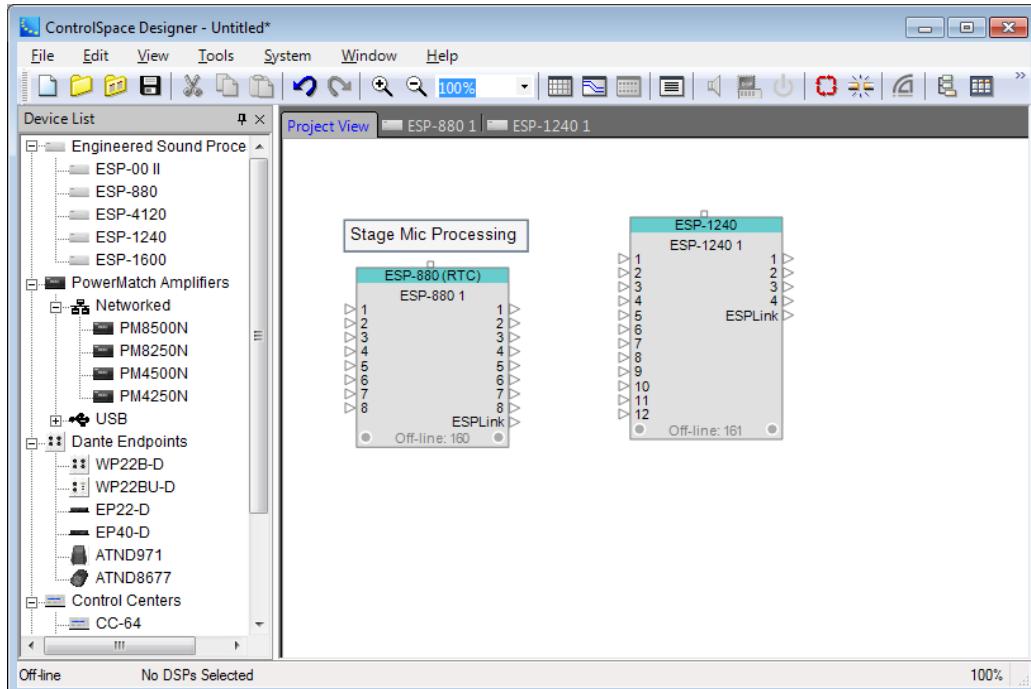
Click and drag the text frame to where you want it.
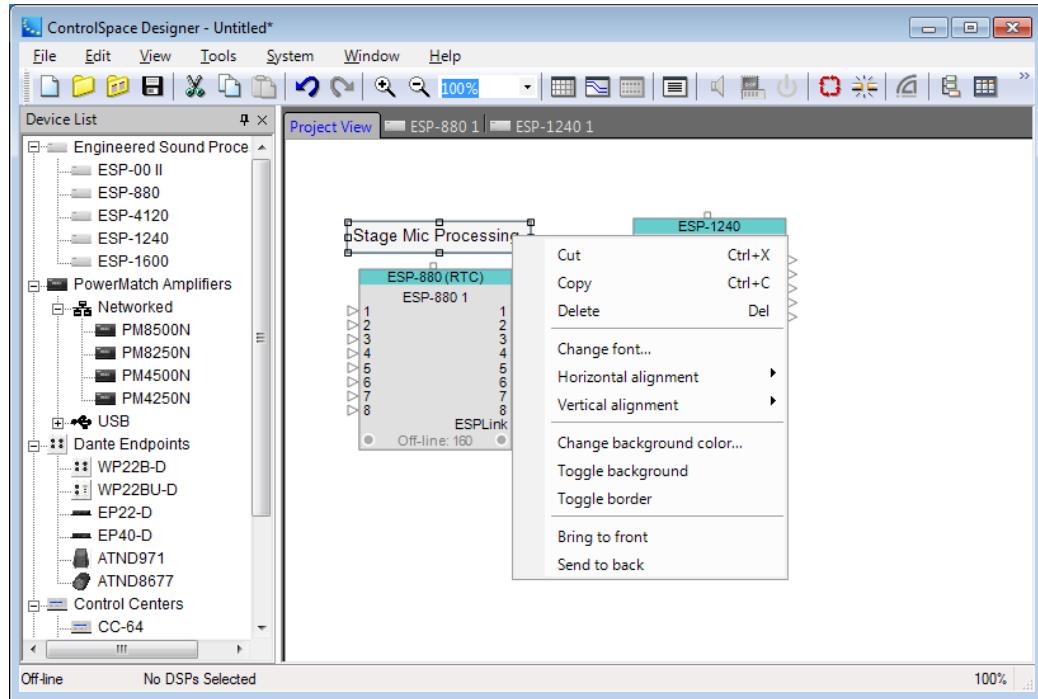
Click inside the text frame. Notice that the text line is highlighted in blue.

Enter the text you want in the frame. When done, click outside the text frame. Select the text frame again to adjust its size and location.

Right-clicking a text frame opens a menu that provides additional editing functions.

Cut, **Copy**, and **Delete** are the standard window functions.

Change font... allows you to select font style and size.

Horizontal alignment offers you the choice of Left, Center, or Right.

Vertical alignment offers you the choice of Top, Center, or Bottom.

Change background color... lets you chose a background color from the color palette.

Toggle background switches between the selected color and no color.
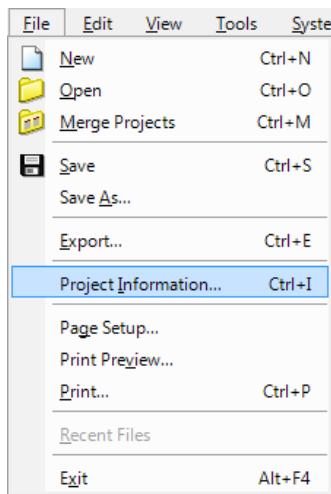
Toggle border switches between a border and no border.

Bring to front places the text frame in front of design icons.
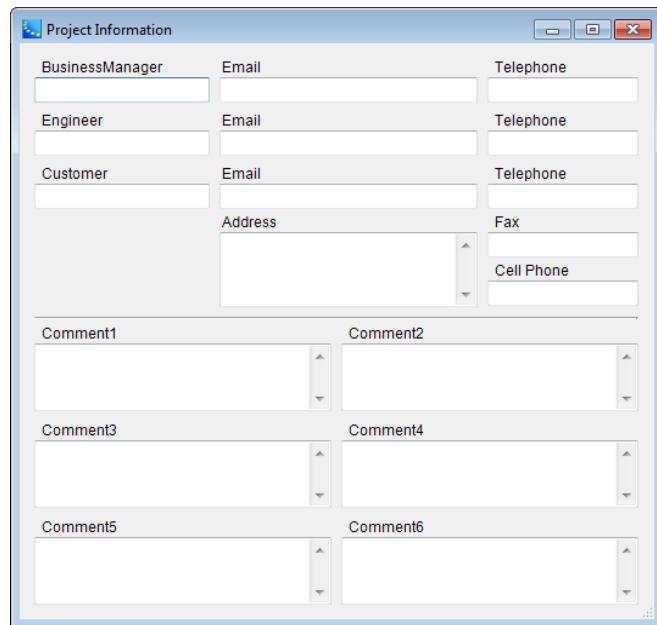
Send to back moves the text frame behind design icons.

Adding project notes

ControlSpace® Designer™ provides a feature for recording contact information and comments related to the project design. This is an especially helpful feature for service technicians accessing the system in the future. To access this feature, Select the File Menu and choose Project Information or by using the (CTRL + I) hot key.
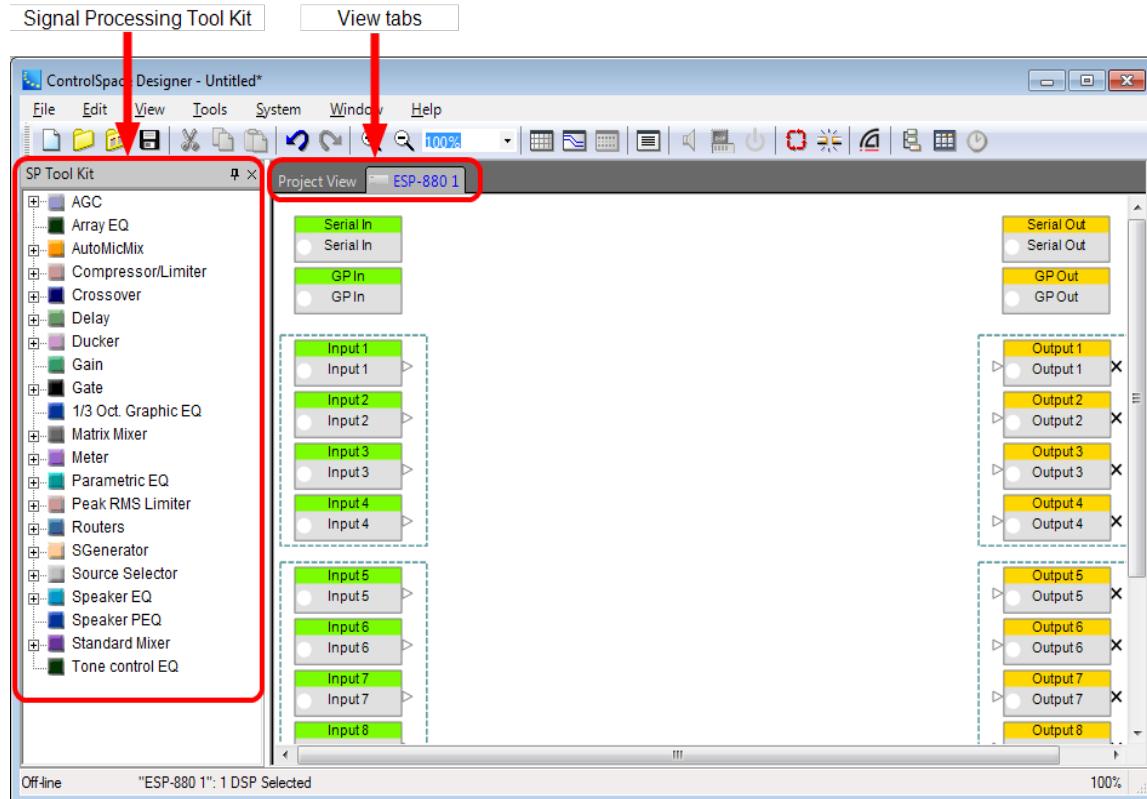
The Project Information Window supports entry of contact information for multiple project participants as well as six multi-line comment fields. There is no limit to the amount of text you may enter in the comment fields, and all information stays with the design when the project file is saved to disk or uploaded to the system.

Project Information Window

Accessing signal processing

Each device that has signal processing functions has a Signal Processing View indicated by a tab to the right of the Project View.

Signal Processing View and SP Tool Kit

The first time you access the **Signal Processing View** you will notice that it is essentially a clean slate. Default input and output blocks are visible for the audio, general purpose, and serial ports of an ESP chassis.

The Signal Processing (SP) Toolkit includes the various signal processing blocks which may be used within the selected device.

Engineered Sound Processors (ESPs)
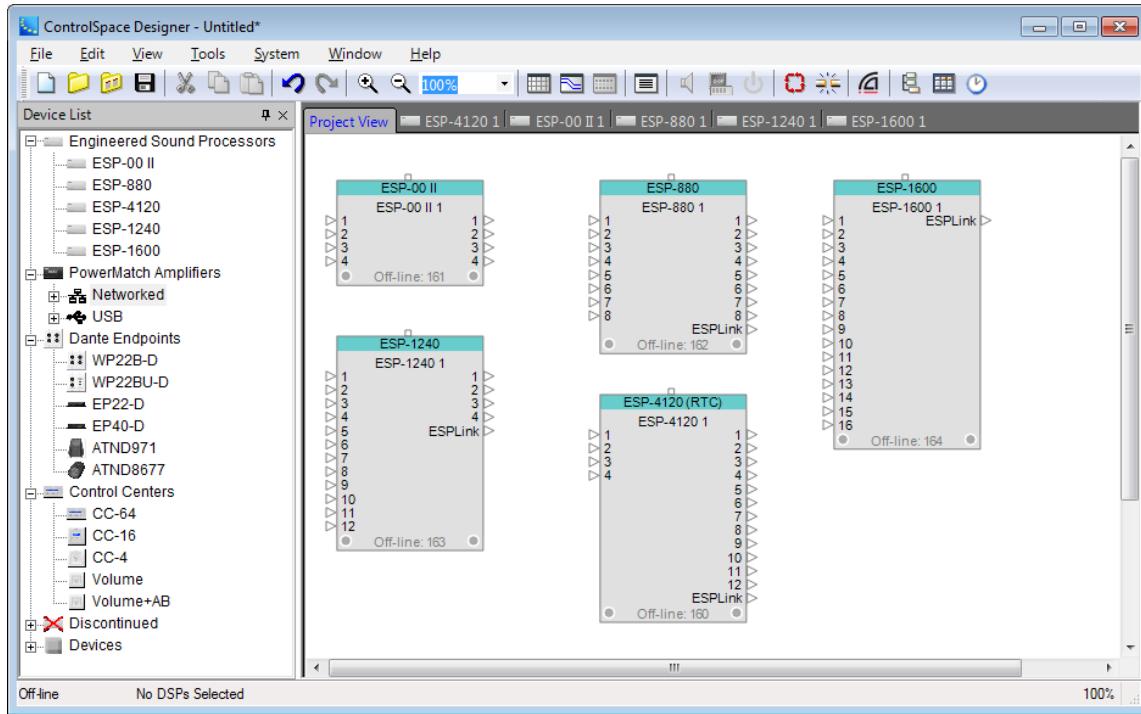
Engineered Sound Processor (ESP) Devices

The **Device List** in the window below shows the available engineered sound processors that may be added to your system design.

- Expandable I/O ESP - ESP-00 II
- Fixed I/O ESPs - ESP-880, ESP-4120, ESP-1240 and ESP-1600

Bose control devices and generic devices are included in the Device List below the Signal Processors. The generic devices are used to illustrate system components and connectivity. These ESPs are added to the Project View using the same drag and drop mechanism as other devices within the ControlSpace® Designer™ software.

NOTE: Wiring within the project view is for informational purposes only and does not affect the audio signal path between devices.
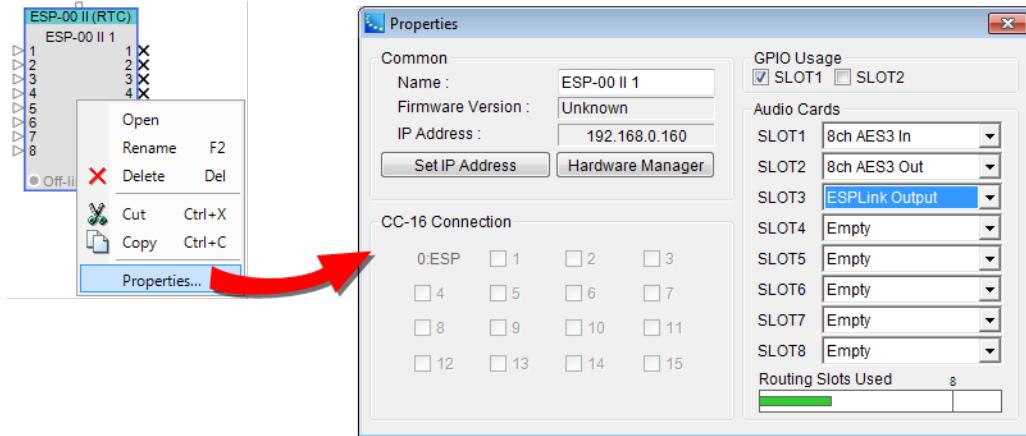
Available engineered sound processors and their associated Project View icons.

ESP-88/00/00 II

ESP-00 II Device Properties

The ESP-00 II engineered sound processor requires the configuration of project-specific input/output cards. This is accomplished through the Properties panel. To access the ESP properties panel, right-click on the engineered sound processor II icon in the Project View and select **Properties**.

ESP-00 II Properties Panel

The Properties panel shows all of the items which determine the configuration of the ESP-00 II.

Common – Contains functions which are common to all ESP-00 II devices:

Name – The unique name of the ESP-00 II that is displayed within the Project View. This unique name is also used in serial protocol programming. The name can be changed by selecting the name and entering a new one.

Firmware Version – Displays the current version of ESP-00 II firmware. This item is only available when on-line with the ESP.

IP Address – Displays the current IP address for the ControlSpace Network port

Set IP Address – Clicking this button allows you to change the IP address of the device.

Hardware Manager – Clicking this button opens the Hardware Manager dialog.
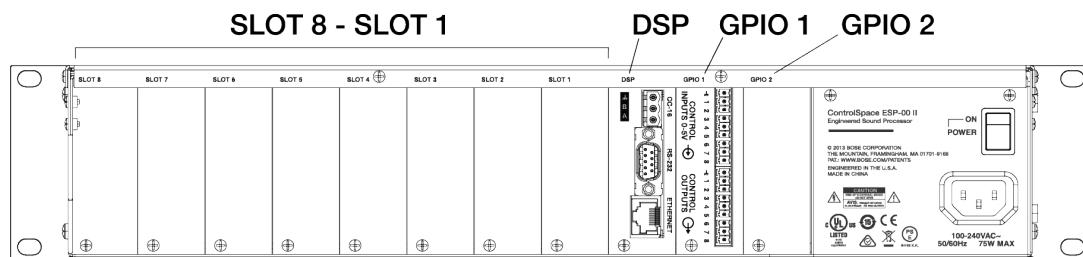
CC-16 Connection – Displays a check mark beside numbers 1 through 15 matching the device ID of each CC-16 connected to the ESP-00 II.

GPIO Usage – Check boxes to enable the general purpose input and output capabilities:

GPIO 1 – Eight control inputs and eight control outputs are provided in each ESP-00 II system as standard equipment.

GPIO 2 – An optional connector card and cable to add eight control inputs and eight control outputs to an ESP-00 II.

Audio Cards - SLOT1 to SLOT8 represent physical hardware slots that can be populated with expansion cards from within the ControlSpace® ESP-00 II architecture.

ESP-00 II Rear I/O Panel

SLOT 1 - SLOT 8 - Within the audio card options, each slot has a drop down menu which lists the audio cards which may be installed:

> 4ch Mic/Line Input II
>
> 4ch Line Output II
>
> 4x4 Mic/Line In
>
> 4ch EDR In
>
> 4ch EDR Out
>
> 8ch AES3 In
>
> 8ch AES3 Out
>
> 4ch Mic/Line In
>
> 4ch SDR Output
>
> Surround
>
> CobraNet 16In16Out
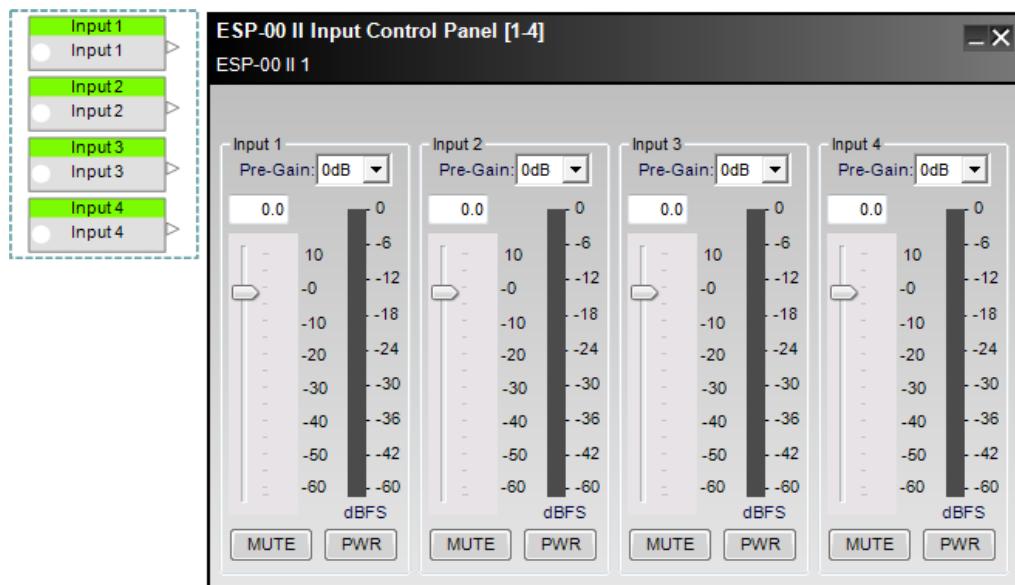
CobraNet 16In8Out

CobraNet 8In16Out

CobraNet 8In8Out

CobraNet 16In

CobraNet 16Out

CobraNet 8In

CobraNet 8Out

ESPLink Output

Dante 16in16out

Dante 8in8out

Dante 16in

Dante 16out

Dante 8in

Dante 8out

Routing Slots Used – A single ESP-00 II can accommodate up to 64 channels of audio. Each card uses some quantity of the 64 channels. The bar graph indicates the current channel usage, and will turn red if the 64 channel maximum has been exceeded.

Audio Card Control Panels

4ch Mic/Line Input II

This expansion card provides four analog channels of software-selectable microphone or line-level inputs.

Adjustable options for this card are accessed by double clicking on any one of the grouped input blocks within the **ESP View** to open the control panel.

4ch Mic/Line Input Control Panel

The **Input Control Panel** provides the following options:

Input 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View of the ESP.

Pre-Gain Control – Allows the selection of a pre-defined amount of analog input gain (0, 14, 24, 32, 44, 54, or 64 dB).

Input Level Text Entry – Permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

Input Gain Slider– Adjusts the input signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

Input Signal Meter - Displays the current input signal level in dBFS at the input to the next processor function. Input meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

PWR - When selected, engages the +48V phantom power.

4ch Line Output II

This expansion card provides four analog channels of software-selectable line-level outputs.

Adjustable options for this card are accessed by double clicking on any one of the grouped output blocks within the **ESP View** to open the control panel.

4ch Line Output Control Panel

The **Output Control Panel** provides the following options:

Output 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View.

Output Level Text Entry - Allows the entry of the amount of attenuation (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the output signal

Output Gain Slider– Adjusts the output signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu.

Output Signal Meter - Displays the current output signal level in dBFS at the input to the next processor function. Output meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

Signal Polarity Control - Reverses the polarity of the signal. Default value is positive (+) or non-inverted. When selected, the signal polarity is negative (-) or inverted. Button color is used to indicate current state with GREEN being non-inverted and RED being inverted.

4x4 Mic/Line Input/Output Card

This expansion card provides four channels of software selectable microphone or line-level standard dynamic range (SDR) inputs with four channels of SDR line-level outputs.

Adjustable options for this card are accessed by double clicking on any one of the grouped input/output blocks within the **ESP View** to open the control panel.

Input Control Panel

4x4 Mic/Line Input Control Panel

The **Input Control Panel** provides the following options:

    Input 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View of the ESP.

Input Type Selection – Provides a selector to configure the range of input pre-gain values for typical **Line** and **Mic** input signal types. This adjustment is in the analog domain, pre analog to digital conversion.

Input Gain – Offers selectable gain options based upon the input type selection. The gain values for **Line** inputs are, 0dB (no additional gain), 14dB, and 24dB. Gain values for **Mic** inputs are, 42dB, 48dB, 54dB, and 64dB.

Input Level Text Entry – Permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

Input Gain Slider – Adjusts the input signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

Input Signal Meter - Displays the current input signal level in dBFS at the input to the next processor function. Input meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

PWR – When selected, engages the +48V phantom power. When phantom power is enabled, the control panel button is Green.

Output Control Panel

4x4 Mic/Line Output Control Panel

The **Output Control Panel** provides the following options:

Output 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View.

Output Level Text Entry - Allows the entry of the amount of attenuation (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the output signal

Output Gain Slider– Adjusts the output signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu.

Output Signal Meter - Displays the current output signal level in dBFS at the input to the next processor function. Output meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

Signal Polarity Control - Reverses the polarity of the signal. Default value is positive (+) or non-inverted. When selected, the signal polarity is negative (-) or inverted. Button color is used to indicate current state with GREEN being non-inverted and RED being inverted.

4ch EDR Input Card

This card provides four channels of enhanced dynamic range (EDR) highest quality line-level input.

Adjustable options for this card are accessed by double clicking on any one of the grouped input blocks within the **ESP View** to open the control panel.

EDR line-level input card control panel

The **Input Control Panel** provides the following options:

Input 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View of the ESP.

Input Gain Slider– Adjusts the input signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

Input Level Text Entry – Permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.
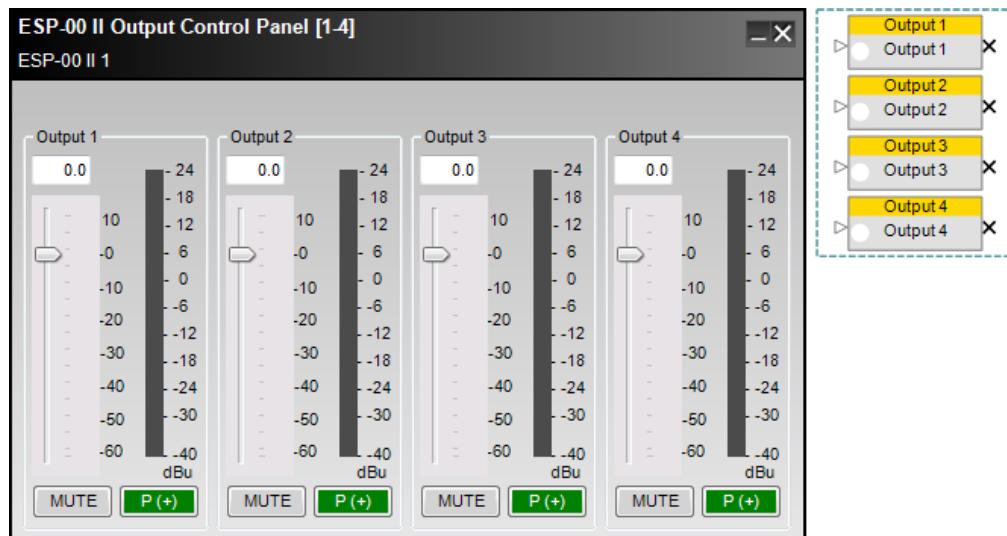
Input Signal Meter - Displays the current input signal level in dBFS at the input to the next processor function. Input meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

4ch EDR Output Card

This card provides four channels of line-level enhanced dynamic range (EDR) highest quality output.

Adjustable options for this card are accessed by double clicking on any one of the grouped output blocks within the **ESP View** to open the control panel.

EDR output card control panel

The **Output Control Panel** provides the following options:

Output 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View.

Output Level Text Entry - Allows the entry of the amount of attenuation (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the output signal

Output Gain Slider– Adjusts the output signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu.

Output Signal Meter - Displays the current output signal level in dBFS at the input to the next processor function. Output meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

Signal Polarity Control - Reverses the polarity of the signal. Default value is positive (+) or non-inverted. When selected, the signal polarity is negative (-) or inverted. Button color is used to indicate current state with GREEN being non-inverted and RED being inverted.

8ch AES3 Input Card

This expansion card provides eight channels of AES3 digital audio input.

Adjustable options for this card are accessed by double clicking on any input block within the **ESP View** to open the control panel.

AES3 eight-channel input card control panel

The **input control panel** provides the following options for each channel:

 Input Gain Slider – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.
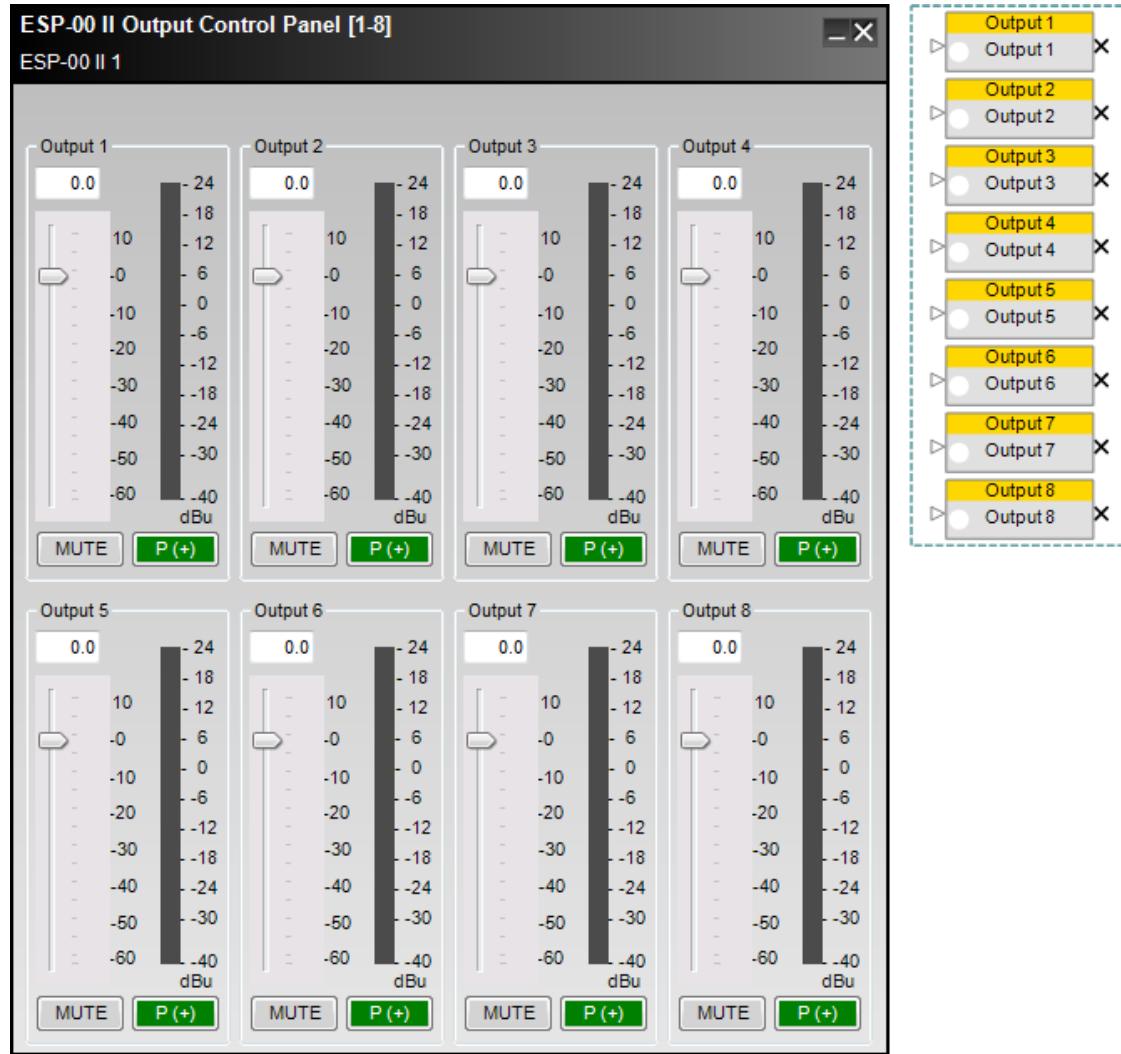
 Input Gain Value – permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

 Mute – silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

8ch AES3 Output Card

This expansion card provides eight channels of AES3 digital audio output.

Adjustable options for this card are accessed by double clicking on any output block within the **ESP View** to open the control panel.

AES3 eight-channel output card control panel

The **output control panel** provides the following options for each channel:

    Output Gain Slider – adjusts the output signal level delivered to the next *device* in the system design. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.
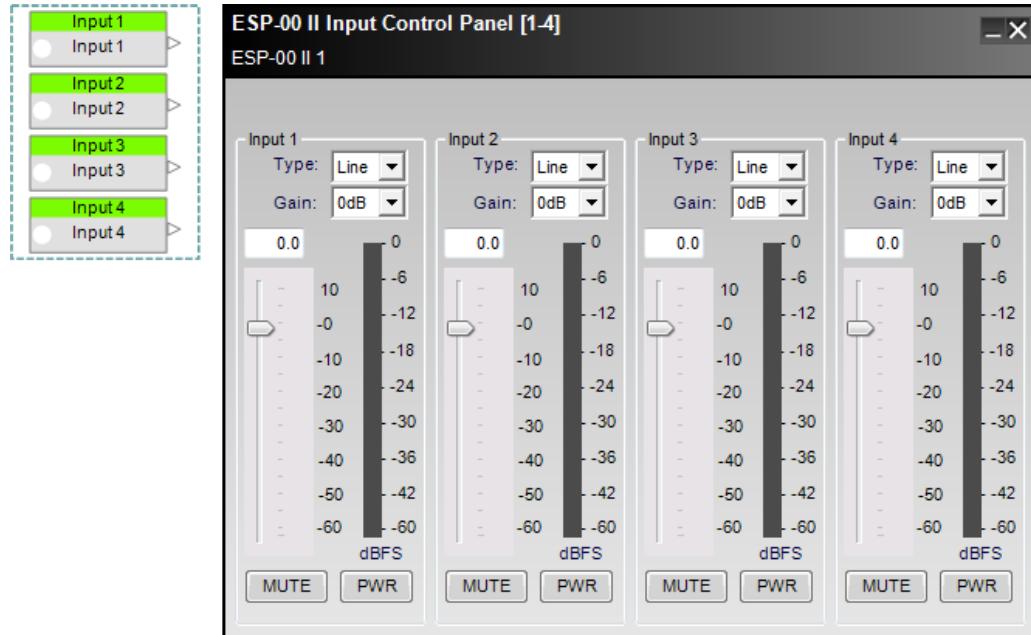
    Polarity – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a "+" sign is present. When Polarity is reversed, the control panel button is Red and a "-" sign is present.

Mute – silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

4ch Mic/Line SDR Input Card

This card provides four channels of software selectable microphone or line-level standard dynamic range (SDR) input.

Adjustable options for this card are accessed by double clicking on any one of the grouped input blocks within the **ESP View** to open the control panel.

Four-channel mic/line SDR input card control panel

The **Input Control Panel** provides the following options:

Input 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View of the ESP.

Input Type Selection – Provides a selector to configure the range of input pre-gain values for typical **Line** and **Mic** input signal types. This adjustment is in the analog domain, pre analog to digital conversion.

Input Gain – Offers selectable gain options based upon the input type selection. The gain values for **Line** inputs are, 0dB (no additional gain), 14dB, and 24dB. Gain values for **Mic** inputs are, 42dB, 48dB, 54dB, and 64dB.

Input Level Text Entry – Permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

Input Gain Slider– Adjusts the input signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

Input Signal Meter - Displays the current input signal level in dBFS at the input to the next processor function. Input meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

PWR– When selected, engages the +48V phantom power. When phantom power is enabled, the control panel button is Green.

4ch Mic/Line SDR Output Card

This card provides four channels of line-level standard dynamic range (SDR) output.

Adjustable options for this card are accessed by double clicking on any one of the grouped output blocks within the **ESP View** to open the control panel.

Four-channel mic/line SDR output card control panel

The **Output Control Panel** provides the following options:

Output 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View.

Output Level Text Entry - Allows the entry of the amount of attenuation (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the output signal

Output Gain Slider– Adjusts the output signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu.

Output Signal Meter - Displays the current output signal level in dBFS at the input to the next processor function. Output meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute– Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

Signal Polarity Control - Reverses the polarity of the signal. Default value is positive (+) or non-inverted. When selected, the signal polarity is negative (-) or inverted. Button color is used to indicate current state with GREEN being non-inverted and RED being inverted.

Surround Sound Decoder Input Card

The surround sound decoder card allows direct connection to the optical or coaxial S/PDIF connection of a CD or DVD player and decodes PCM, Dolby Digital and DTS audio formats.

The surround **processing block** provides eight outputs for the various surround channels decoded at its input and are labeled as follows:

L = Left

R = Right

Ls = Left surround

Rs = Right surround

C = Center

LFE = Low Frequency Effects

Bsl = Back surround left

Bsr = Back surround right

Adjustable options for this card are accessed by double clicking on the appropriate processing block within the **ESP View** to open the surround control panel.

Surround Sound Decoder Input Card input block and control panel

The surround **control panel** provides the following options:

Input Gain – contains adjustable values for multi-channel surround sound input signals. Included in this section are:

> **Master Gain Slider** – adjusts the overall signal level delivered to the next gain stages. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain.

> **Master Gain Input Value** - permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input master gain slider.

Input Select – determines which input connector to use for S/PDIF surround sound signal decoding. Options include:

> **Coax** – an unbalanced RCA

> **Optical** – a TOSLINK optical connector is used for this type of digital audio input.

Input Levels (dB) – permits individual input channel adjustment for each of the eight surround channels. Type a value directly into the level box or right-click on the field to access a gain slider. Individual channels supported are:

Left	Center	Right
Left Surround (Ls)	Low-Frequency Effects (LFE)	Right Surround (Rs)
Back Surround Left (Bsl)		Back Surround Right (Bsr)

X-Curve - equalization can be applied to all signal channels without using DSP resources in the ESP. Options in this section include:

> **On** – enables the X-Curve to all channels.

> **Off** – disables the X-Curve to all channels.

> **Auto** - configures the decoder to automatically activate X-Curve equalization based on the room-type encoding in the media.

> **NOTE: When the decoder detects content with an X-Curve encoding, X-Curve is engaged. The On and Off buttons indicate the current state of the X-Curve EQ when online.**

System Tuning –assists with surround system setup by sending test sources to individual channels which simplifies surround sound tuning and verification. Options in this section include:

> **On / Off** – enables system tuning mode when **On** and routes the current playback source to surround outputs. When **Off**, the current playback source is disconnected from surround outputs.

> **Setup** – opens the system tuning control panel.

Surround Sound Decoder Input Card system tuning control panel

Options in this control panel include:

Playback Source – provides a drop-down list to determine which surround card input channel is routed to the decoder. Input options available are:

Source (Left) – Left channel only

Source (Left+Right) – Both left and right channels

Source (Center) – Center channel only

Source (Pink Noise) – Pink noise is used as the input signal

Playback Channel – provides a drop-down list to determine which individual surround output channels receive the chosen **Source**. The list is ordered as:

Left – Left front

Center – Center front

Right – Right front

Rs – Right surround

Bsr –Back surround right

Bsl –Back surround left

Ls - Left surround

LFE – Low Frequency Effects

Back – is a quick-select button to enable the surround output above the currently active output in the list above. When the top of the list is reached, the next button press jumps to the output the bottom of the list and continues moving up the list on each press.

Next – is a quick-select button to enable the surround output below the currently active output in the list above. When the top of the list is reached, the next button press jumps to the output the top of the list and continues moving down the list on each press.

Mute – when enabled, the button turns red and all surround outputs are muted. This is the default condition when **System Tuning** is turned **ON**. When disabled, the button turns gray and the currently defined **Playback Channel** becomes active.

Media Type – this section provides monitoring, programming, and testing of various media-based events. Options available within this area of the surround sound control panel include:

Current Media Type - displays the type of media format that is active at the surround card inputs. This state is updated when connected to an ESP and in **on-line** mode. It will appear blank while in **off-line** mode.

Test Media Type – is used to a select a media type from the drop-down list to invoke and verify the actions assigned to that Media Type.

NOTE: The Test Media Type drop-down list is disabled when on-line.

Media Type Programming – is used to trigger a media type-specific parameter sets. When a specific input format is identified and decoded from the digital bitstream, the listed Media Type is recalled to perform the actions defined in its programming.

Individual media types are listed in the **Type of Input** tree and programming events are assigned to one or more types while off-line.

```
⊟ Type of Input
    ⋯ No Signal
    ⋯ PCM
    ⋯ Dolby Digital 5.1
    ⋯ DTS 5.1
    ⋯ DTS-ES Matrix 6.1
    ⋯ DTS-ES Discrete 6.1
    ⋯ Dolby Digital 1.0
    ⋯ Dolby Digital 2.0
    ⋯ DTS 1.0
    ⋯ DTS 2.0
    ⋯ DTS 2/1
    ⋯ DTS 3.0
    ⋯ DTS 4.0
    ⋯ DTS 5.0
```

Surround Sound control panel Media Type of Input Tree

To associate a Parameter Set with a media type, drag the Parameter set onto the desired media type in the list. For example, one Parameter Set can be programmed to change the signal routing and provide some equalization for a stereo CD signal while another can be programmed to signal a projector to power on and lower the projection screen for a Dolby 5.1 DVD demonstration.
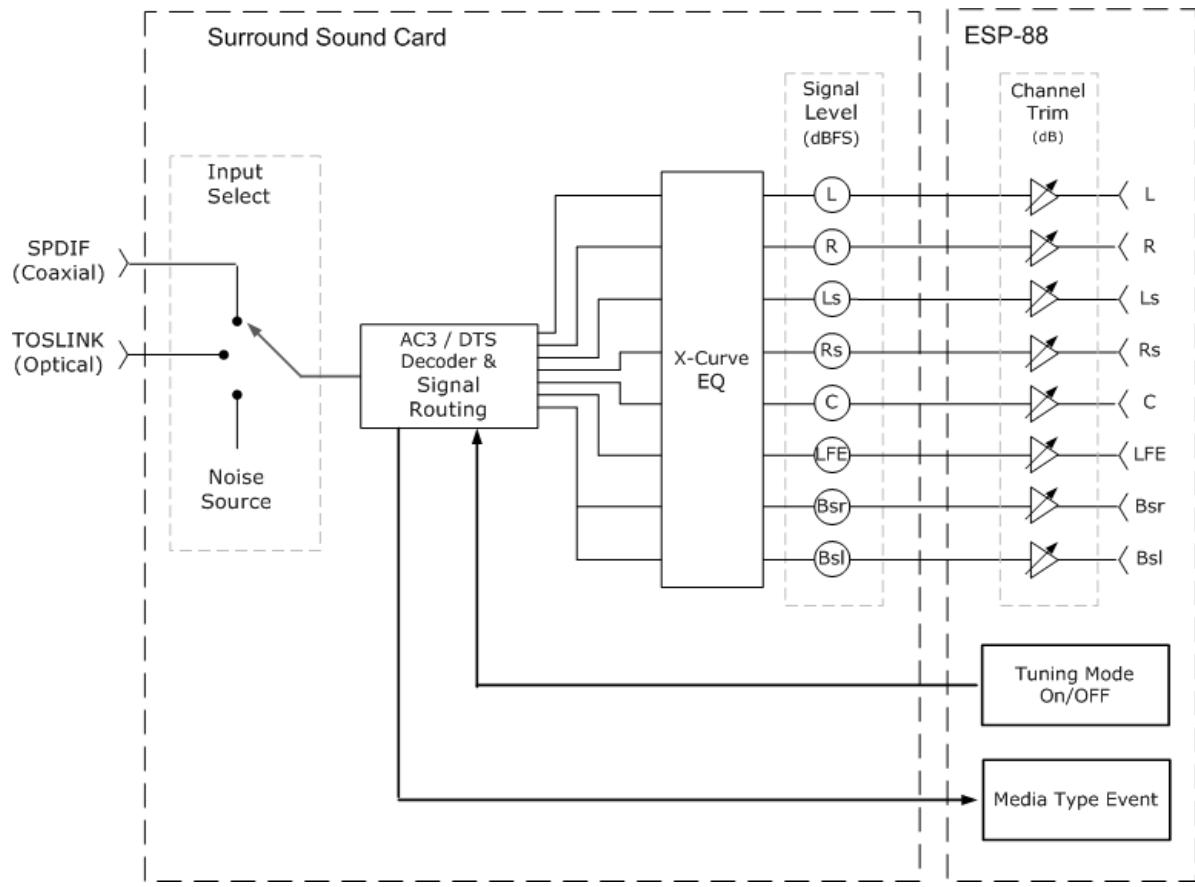
For more programming information, see Parameter Sets.

Media Types are identified and recalled based upon the signal format table shown below:

Format	Sample Rate	Media Type
Format	Sample Rate	Media Type
PCM (CD)	44.1 kHz	PCM
PCM (DVD Video)	48 kHz	PCM
Dolby Digital 1.0	48 kHz	Dolby Digital 1.0
Dolby Digital 2.0	48 kHz	Dolby Digital 2.0
Dolby Digital 5.1	48 kHz	Dolby Digital 5.1
DTS 1.0	48 kHz	DTS 1.0
DTS 2.1	48 kHz	DTS 2.1
DTS 3.0	48 kHz	DTS 3.0
DTS 4.0	48 kHz	DTS 4.0
DTS 5.0	48 kHz	DTS 5.0
DTS 5.1	48 kHz	DTS 5.1
DTS ES Discrete 6.1	48 kHz	DTS ES Discrete 6.1
DTS ES Matrix 6.1	48 kHz	DTS ES Matrix 6.1
DTS CD	44.1 kHz	DTS 5.1

Functional Diagram

The following functional diagram depicts the signal flow and logic operation of the surround decoder input card.

Surround Sound Decoder Input Card functional diagram

CobraNet Input/Output Card

The Bose® ESP-00 II/88 engineered sound processor is capable of supporting up to 64 audio channels divided into eight routing slots of up to eight channels each. Typically, an expansion card occupies one physical slot and provides four to eight channels of audio. One exception is the standard 4x4 input/output card which occupies two physical expansion slots (to allow enough space for the output connectors) but only requires one routing slot (eight channels total).

The CobraNet expansion card is unique as it only occupies one physical slot but can support up to 32 channels (16 in, 16 out) and can therefore utilize up to four of the eight available routing slots. For convenience the card can be configured to provide eight possible I/O combinations. This allows the card to be configured according to project requirements while leaving the maximum number of routing slots free for other expansion cards.

Depending on the number of routing slots allocated to the CobraNet card the number of additional expansion cards (other than the standard 4x4 card) that can be added may be less than the physical expansion slots available as demonstrated in the table below.
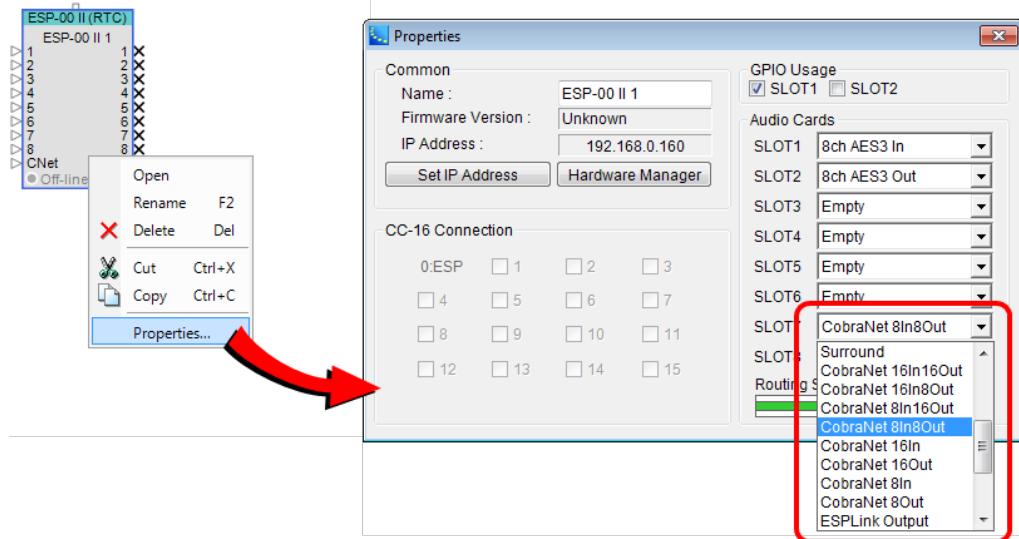
CobraNet I/O Configuration	Routing Slots Used	Additional I/O Card Capacity
16 in, 16 out	4	4

CobraNet I/O Configuration	Routing Slots Used	Additional I/O Card Capacity
16 in, 8 out	3	5
8 in, 16 out	3	5
8 in, 8 out	2	6
16 in, 0 out	2	6
0 in, 16 out	2	6
8 in, 0 out	1	7
0 in, 8 out	1	7

Defining the CobraNet® Input/Output Card Configuration

The CobraNet card is added to the ESP-00 II/88 in the same manner as other expansion cards. If the card has already been fitted it will be detected automatically when a hardware scan is performed, otherwise the card can be added manually as follows:

Right-click on the ESP icon in Project View and select **Properties** to display the ESP Properties dialog box.
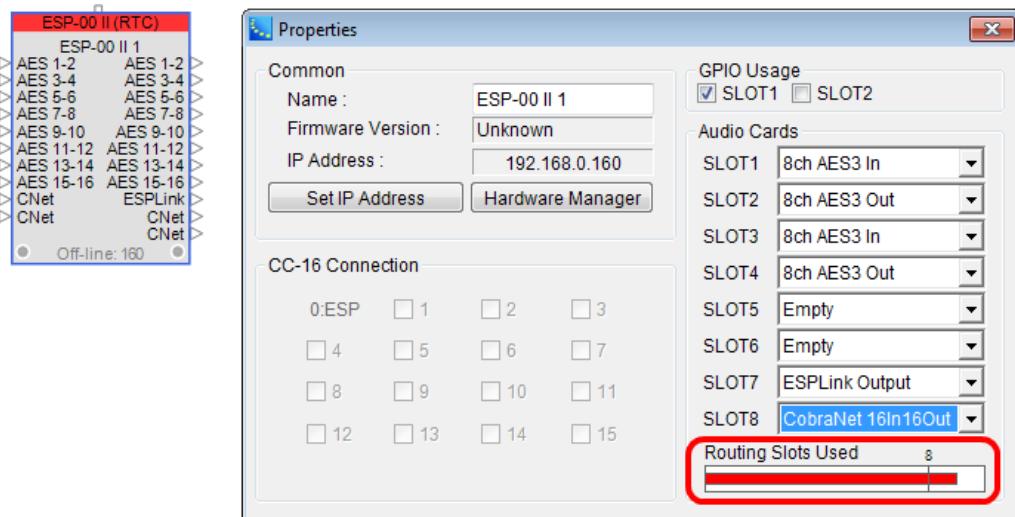
CobraNet Card Configuration within ESP Properties

Select the required CobraNet card variant from the drop-down list presented for the audio card slot where the card will be installed.

NOTE: Only one CobraNet I/O card may be installed within an ESP-00 II/88.
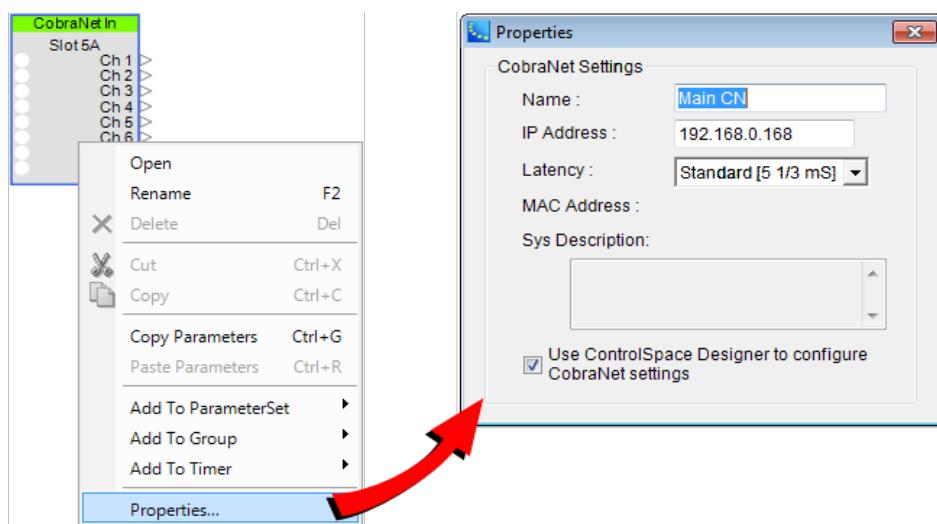
When used in conjunction with other expansion cards you will need to ensure that the eight available routing slots are not exceeded. If this occurs the **Routing Slots Used** meter and relevant ESP icon in Project View will turn red as shown below:

Indication of available routing slots exceeded

CobraNet Properties

The global **Properties** control panel for the CobraNet expansion card is accessible by right-clicking on any CobraNet input or output module within the **ESP View** and selecting **Properties**.

CobraNet Input/Output card Properties

Name – can be any text description that is appropriate for the system design.

IP Address – is equal to that of the host ESP plus eight (e.g. 192.168.0.168 for an ESP address of 192.168.0.160) but may be adjusted to any alternate address if necessary.

NOTE: An IP address is only necessary when the CobraNet card is managed by SNMP or similar network monitoring devices and is unreferenced in normal operation.

Latency – is a drop-down list providing selection between three standard latency modes used in CobraNet networks. Higher latencies provide more tolerance for network propagation delays. The latency modes provided are:

Standard (5 1/3 mS)

Low (2 2/3 mS)

Lowest (1 1/3 mS)

NOTE: All CobraNet devices on a network must use the same latency mode to transmit and receive audio correctly.
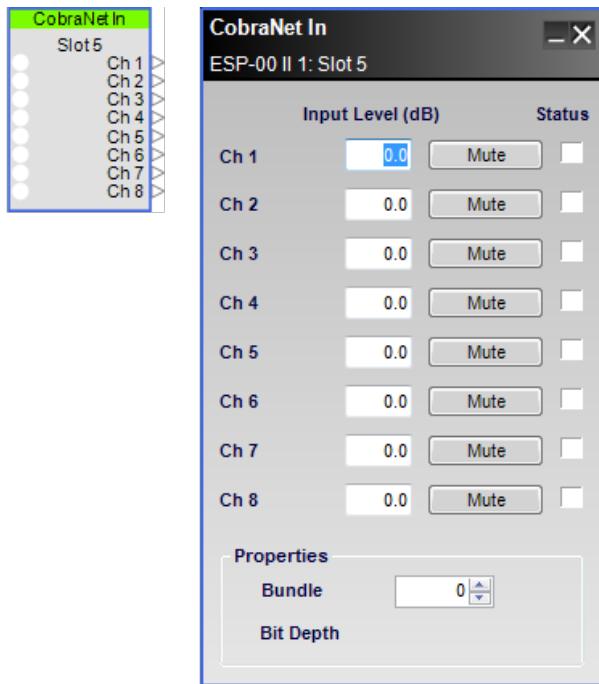
MAC Address – is a read-only field displaying the unique MAC address assigned to each individual CobraNet card during manufacture.

Sys Description – provides information about the CobraNet card circuitry version.

NOTE: Both MAC address and Sys Description are visible only after connecting to an ESP in on-line mode. Both fields appear blank while in off-line mode.

Use ControlSpace Designer to configure CobraNet settings –is checked by default. However, if access to advanced CobraNet properties is required, remove the check mark to disable ControlSpace Designer access to the CobraNet card. Thereafter, all configurations are performed via the network using the CobraNet Discovery utility or similar software management tool.

Adjustable options for the CobraNet Input Card are accessed by double clicking on the appropriate CobraNet block within the **ESP View** to open its channel control panel.

Eight-channel CobraNet card input control panel

Each eight-channel **input control panel** provides the following options for Ch 1 through Ch 8, the individually addressable *receivers* synchronizing with digital audio sent from other CobraNet transmitters.

Input Level (dB) – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital CobraNet domain. Type a value directly into the input level box or right-click on the field to access a gain slider.

Mute – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

Status – indicates the presence of valid CobraNet data for each channel while ControlSpace Designer is on-line. The status colors represent the the following conditions:

Black - Channel not being received

Green - Channel being received correctly
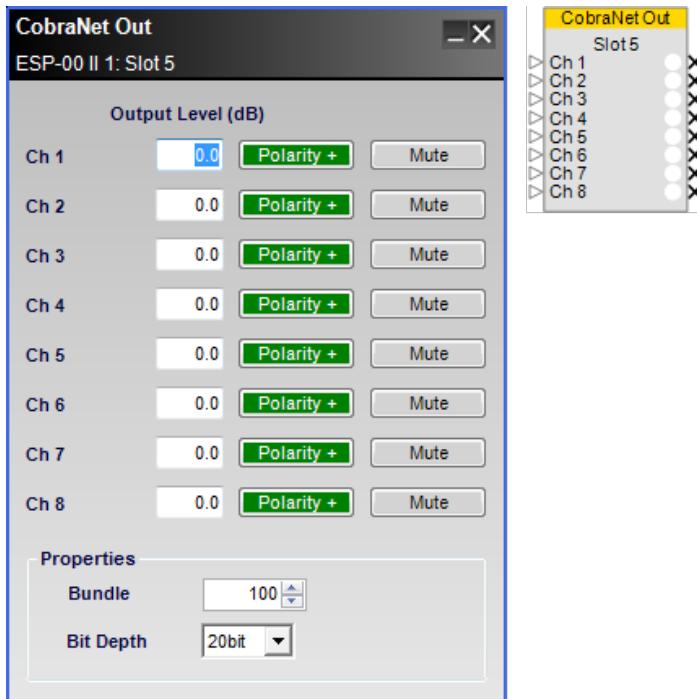
Red - Channel being received with errors (due to incorrect latency or network issues.).

Properties – this area of the input control panel contains an adjustable field for entry of the CobraNet bundle.

Bundle – is an identification number from (0) to (65279) which matches the corresponding upstream *transmitter* of synchronized digital audio. The default value of (0) disables reception of network audio for as long as the port is unused.

Bit Depth - is read-only field and will be populated while ControlSpace Designer is on-line and audio is being received.

Adjustable options for the CobraNet Output card are accessed by double clicking on the appropriate CobraNet block within the **ESP View** to open its channel control panel.

Eight-channel CobraNet card output control panel

Each eight channel **output control panel** provides the following options for CH 1 through Ch 8, the individually addressable *transmitters* sending synchronized digital audio to other CobraNet receivers.

Output Level (dB) – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dBu. This adjustment point is in the digital CobraNet domain. Type a value directly into the output level box or right-click on the field to access a gain slider.

Polarity – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and a minus (−) sign is present.

Mute – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

Properties – this area of the input control panel contains an adjustable field for entry of the CobraNet bundle.

> **Bundle** – is an identification number from (0) to (65279) which matches the corresponding downstream *receiver* of synchronized digital audio. The default value of (0) disables reception of network audio for as long as the port is unused.

> **Bit Depth** - adjusts the sample resolution for transmitted digital audio. The options are 16 bit (default), 20 bit and 24 bit. For proper audio synchronization, same Bit Depth should be used for receivers of the same bundle.
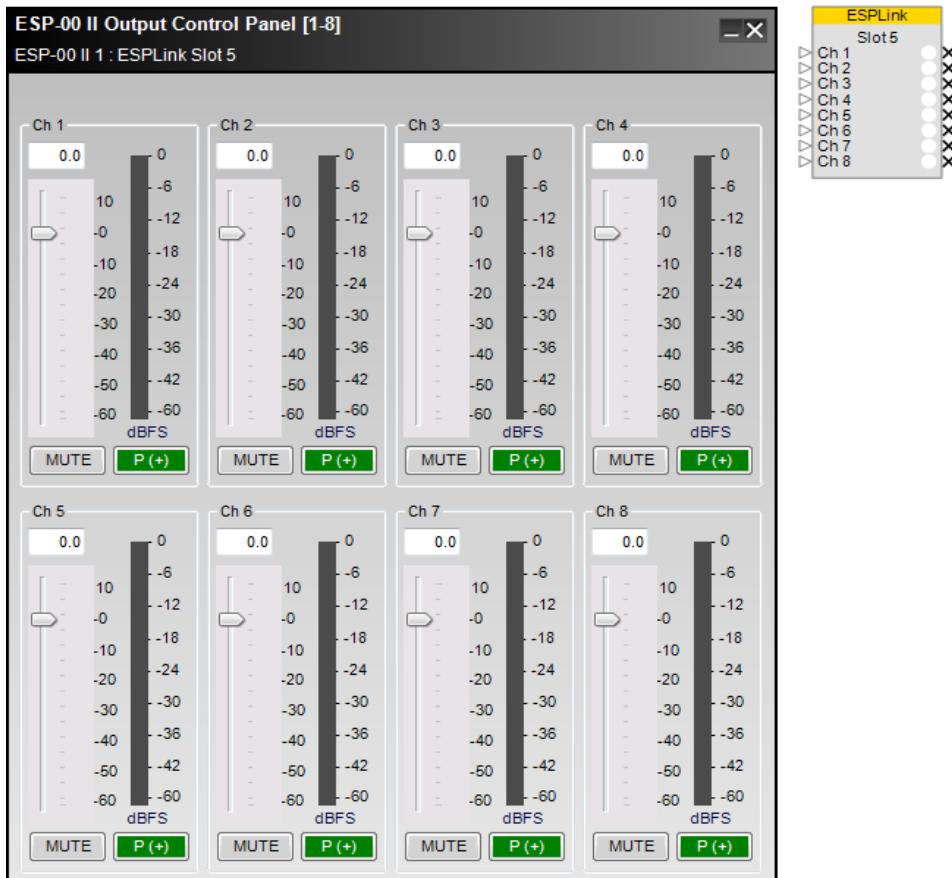
> **NOTE: A Bit Depth of 24 bit used with Standard [5 1/3mS] latency in the CobraNet card properties, reduces the number of channels in a Bundle to seven (7).**

NOTE: For more information on configuring Bose professional system electronics for use with CobraNet network audio, refer to the CobraNet application notes available at http://pro.Bose.com.

8ch ESPLink Output Card

This card provides eight channels of digital audio output via TOSLINK optical connector.

Adjustable options for this card are accessed by double clicking on any output block within the **ESP View** to open the control pane for all channels.

ESPLink Card output control panel

The **output control panel** provides the following options for each channel:

    Output Gain Slider – Adjusts the output signal level delivered to the next *device* in the system design. The range of adjustment is from –∞ to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.

    Output Signal Meter - Displays the output signal level in dBFS at the input to the next processor function.

    Mute – Silences the signal and disables audio from passing to the next gain stage in the design. When **Mute** is enabled, the control panel button is Red.

    Signal Polarity Control - Reverses the polarity of the signal. Default value is positive (+) or non-inverted. When selected, the signal polarity is negative (-) or inverted. Button color indicates current state with GREEN being non-inverted and RED being inverted.

Dante™ Network Card

The Bose ESP-00 II/88 engineered sound processor is capable of supporting up to 64 audio channels divided into eight routing slots of up to eight channels each. The Dante digital audio network expansion card is unique as it only occupies one physical slot but can support up to 32 channels (16 in, 16 out) and can, therefore, utilize up to four of the eight available routing slots. For convenience, the card can be configured to provide eight possible I/O com-

binations. This allows the card to be configured according to project requirements while leaving the maximum number of routing slots free for other expansion cards.
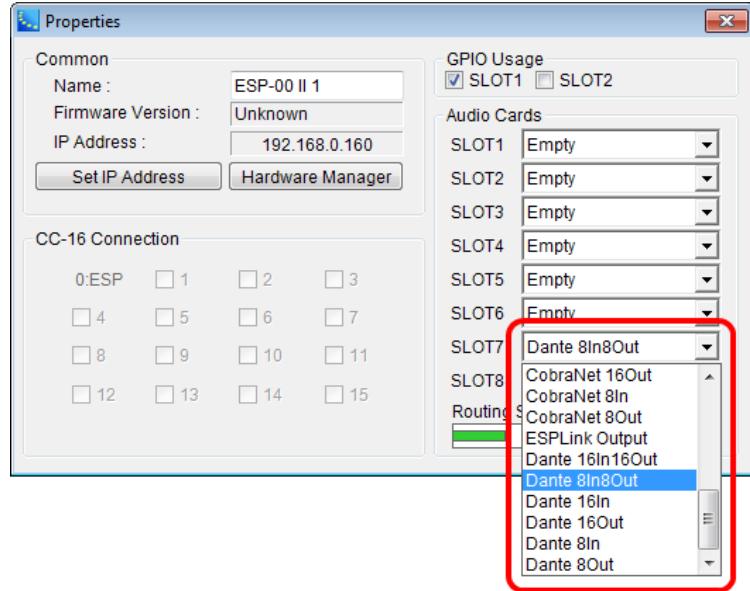
Depending on the number of routing slots allocated to the Dante digital audio network card the number of additional expansion cards (other than the standard 4x4 card) that can be added may be less than the physical expansion slots available as demonstrated in following table.

I/O Configuration	Routing Slots Used	Additional I/O Card Capacity
16 in, 16 out	4	4
8 in, 8 out	2	6
16 in, 0 out	2	6
0 in, 16 out	2	6
8 in, 0 out	1	7
0 in, 8 out	1	7

Defining the Dante™ Card Configuration

The Dante digital audio network card is added to the ESP-00 II/88 in the same manner as other expansion cards. If the card has already been fitted it will be detected automatically when a hardware scan is performed. Otherwise, the card can be added manually to the system design as follows:

In Project View, right-click on the ESP-00-II icon and select Properties to display the ESP-00-II Properties dialog box.
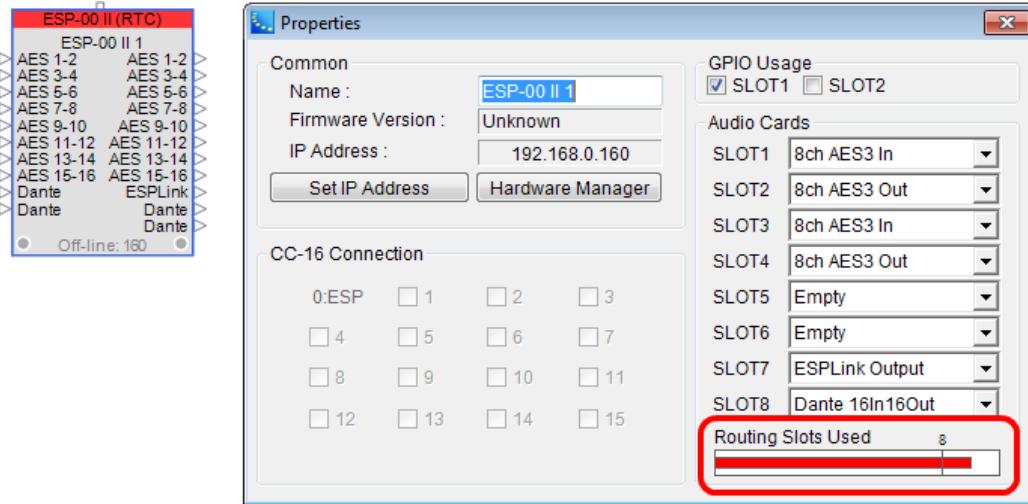
Dante Digital Audio Network Card Configuration within ESP Properties

In the drop-down list, select the desired I/O configuration for the audio card slot where the card will be installed.

NOTE: Only one Dante network card or one CobraNet network may be installed in an ESP-00 II/88. The ESP-00-II/88 does not support the bridging of different digital audio network types.

When used in conjunction with other expansion cards you will need to ensure that the eight available routing slots are not exceeded. If this occurs the Routing Slots Used meter and relevant ESP icon in Project View will turn red as shown in the following example:
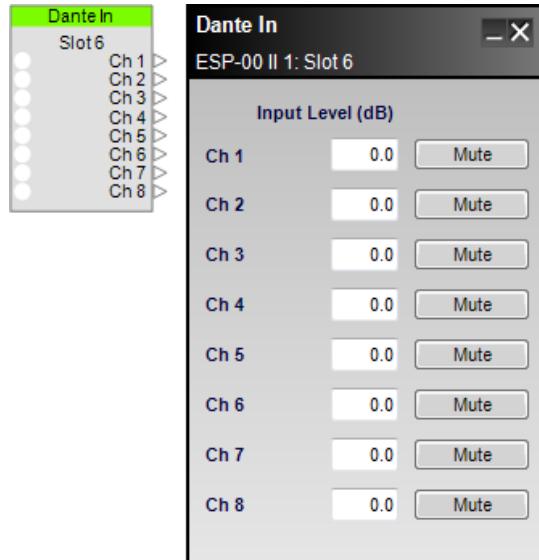
Indication of available routing slots exceeded

For information on the Dante global properties control panel, "Dante™ Network Card Properties" on page 351.

Dante Network Card Input/Output Control

The Dante digital audio network cards offer a basic set of input and output controls, which can be accessed by double-clicking on the Dante input/output processing blocks.

The input controls of the Dante card are accessed by double clicking on the appropriate Dante input block within the Signal Processing View of the ESP.

Eight-channel Dante network card input control panel

Each eight-channel Dante input control panel provides the following controls:

> **Input Level (dB)** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain. Type a value directly into the input level box or right-click on the field to access a gain slider.

> **Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

The output controls of the Dante card are accessed by double clicking on the appropriate Dante output block within the Signal Processing View of the ESP.

Eight-channel Dante network card output control panel

Each eight channel output control panel provides the following controls:

> **Output Level (dB)** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain. Type a value directly into the output level box or right-click on the field to access a gain slider.

> **Polarity** – applies a reversal of polarity to the output signal. When Polarity is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and a minus (−) sign is present.

> **Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

GPIO (ESP-00 II)

The ESP-00 II has 8 General Purpose Input and Output (GPIO) ports which may be expanded to 16 GPI with the addition of a GPIO expansion card. GPI ports are used to connect external hardware such as potentiometers (to control levels or gains) and switches (contact closures) to invoke parameter sets. Functions are assigned to these external controls in the GPI control panel.

GPI control panel

Adjustable input options are accessed by double clicking the appropriate **GPI** block within the **ESP View** to open its control panel.

General Purpose Input (GPI) control panel

Activity - indicators notify the user when a GP input or output is active. Green indicates an active input/output, or when a **Test** button is pressed.

Mode buttons – Determine the operating mode for each general purpose input. Eight input modes are available within each processing block. Left click the operating mode button to toggle through the three supported modes:

Mode	Description
Digital 	Typically used when connecting a switch or push button, this mode expects a normally open switch for operation. Both "on" and "off" actions are supported
Up/Down 	Up/Down mode uses two adjacent GPI, and is intended to support two push buttons for use as volume up and down. Normally open switches are expected.
Analog 	Analog mode is intended for a 10 KOhm linear type potentiometer that can be linked to a single or group of gain controls. Select **A+** if the pot measures 0 ohms when fully *counter-clockwise* and 10K ohms when fully *clockwise*. Select **A–** if the pot measures 0 ohms when fully *clockwise* and 10K ohms when fully *counter-clockwise*.

Test buttons - Permit verification of programmed actions for each input. Appearance and function of the test buttons change dynamically with each operating mode.

Mode	Test Operation
Digital D	Single left click per test button activates "on" or "off" conditions.
Up/Down ↑ ↓	Single left click per test button activates "up" or "down" conditions.
Analog A+ A-	Analog mode is intended for a 10 KOhm linear type potentiometer that can be linked to a single or group of gain controls. Select **A+** if the pot measures 0 ohms when fully *counter-clockwise* and 10K ohms when fully *clockwise*. Select **A–** if the pot measures 0 ohms when fully *clockwise* and 10K ohms when fully *counter-clockwise*.
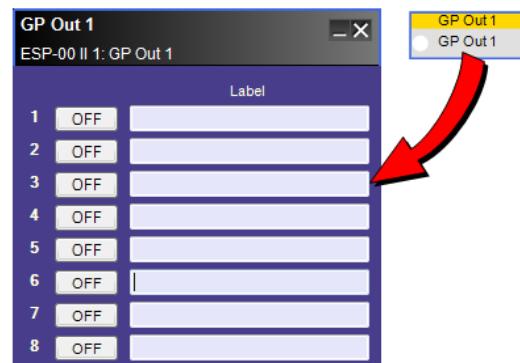
The lower section of the control panel provides a programming tree to assign functions invoked by the eight General Purpose Inputs. You can drag and drop signal processing blocks, parameter sets, or groups onto the text lines.

See Programming GPIO for programming examples.

GPO control panel

Output functions are accessed by double clicking the appropriate **GPO** block within the **ESP View** to open its control panel.

Buttons 1-8 correspond to the state of each individual general purpose output port. Click a button to set the state of an output to OFF (default) or ON before assigning the GPO processing block in ESP View to a location in the Project Directory or Parameter Set Nodes List.

General Purpose Output (GPO) control panel
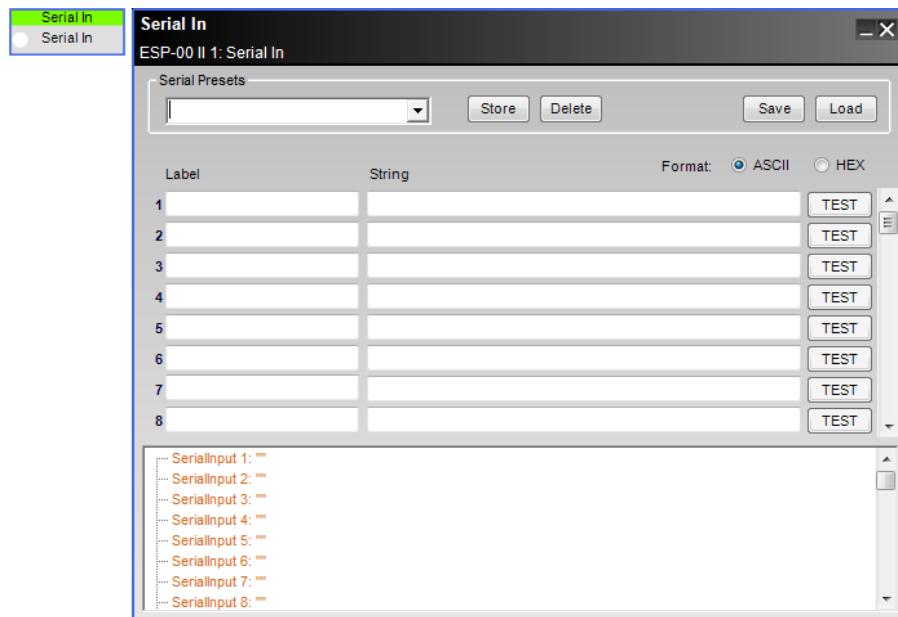
See Programming GPIO for programming examples.

Serial Input-Output (ESP-00 II)

Serial Command Support is provided for the ESP-00 II via the integral serial port on the rear I/O panel of the ESP and by a built-in serial command protocol (See application note ControlSpace® Serial Protocol v4.3). Up to 64

serial input or output strings are supported. Double-click on the Serial Input or Serial Output blocks in ESP View to open their control panels.

Serial Input

Serial Input processing block and control panel

The **Serial Input control panel** provides the following options:

Serial Presets - allow the user to create "snapshots" of serial settings. The snapshot can then be exported as a "serial preset file" for future use, and used to build a serial preset file. These items behave identically to the Parametric EQ presets list.

Store - commits the current preset settings to memory. Snapshot names and settings become part of the design file when saved to disk.

Delete - removes the currently selected snapshot from the drop down list but retains the preset settings until a new snapshot is selected.

Save - exports the selected preset to a user-specified location on a hard drive.

Load - uploads a selected preset file

Label – used for entering a label to keep track of the serial **String**.

String – provides a location to store up to 64 ASCII characters or 64 HEX characters to match commands received from external devices via the RS-232 serial port. Matching commands received within the serial data stream perform actions specified in the programming tree.

Format:

ASCII/HEX– radio buttons determine the unit scale for text entry. Select ASCII for traditional alpha-numeric character entry or HEX to convert notation to two-bytes per character.

TEST - allows the user to test the programming for a specified serial string. If no target is assigned to the serial string, the "TEST" control is disabled. Serial output TEST controls are only active when online.

Serial Input Programming Tree– provides a drag-n-drop area for assigning ESP functions to perform (block values or parameter sets) when matching serial strings arrive at the serial input.

NOTE: An ESP automatically assumes each input string terminates with one carriage return (CR). You must program the sending equipment to terminate the serial string with one CR at the end of each command. It is unnecessary to include this CR in the Serial Input entry windows.

Serial Output

Serial output processing block and control panel

The **Serial Output control panel** provides the following options:

Serial Presets - allow the user to create "snapshots" of serial settings. The snapshot can then be exported as a "serial preset file" for future use, and used to build a serial preset file. These items behave identically to the Parametric EQ presets list.

Label – used for entering a label to keep track of the serial **String**.

String – provides a location to store up to 64 ASCII characters or 64 HEX characters to match commands received from external devices via the RS-232 serial port. Matching commands received within the serial data stream perform actions specified in the programming tree.

Format:

ASCII/HEX– radio buttons determine the unit scale for text entry. Select ASCII for traditional alpha-numeric character entry or HEX to convert notation to two-bytes per character.

TEST -provides the facility to test actions specified in the programming treefor a serial input as if those values just arrived within the serial data stream.

NOTE: Use Hex notation when designating a control character like CR of LF. To designate a hex character, use backslash 0, then the hex value of the character (O - F).

ESP-880/1240/4120/1600

Device Properties of Fixed ESPs

Each of the three fixed I/O ESP models is configured through the Properties panel. To access the ESP properties panel, right-click on the ESP-880/1240/4120/1600 icon in the Project View and select **Properties**.

ESP-4120 Properties Panel

The Properties panel shows all of the items which determine the configuration of the ESP.

Common – Contains functions which are common to ESP 880/4120/1240/1600 devices:

> **Device Name** – The unique name of the ESP that is displayed within the Project View. This unique name is also used in serial protocol programming. The name can be changed by selecting the name and entering a new one.

> **Firmware Version** – Displays the current version of the firmware in the ESP. This item is only available when on-line with the ESP.

Expansion Card - This field allows the user to select between available expansion cards: ControlSpace Network or Dante. This is the only method to define the presence of a ControlSpace Network card while offline.

CC-16 Connection – Displays a check mark beside numbers 1 through 15 matching the device ID of each CC-16 connected to the ESP.

ControlSpace Network– Displays the current IP address for the ControlSpace Network port. When configured for DHCP, the device address is disabled. When configured for Fixed IP, the device address is enabled. To change the network connection type, the Network Setup control panel must be used.

> **Set IP Address** – Clicking this button allows you to change the IP address of the device.

> **Hardware Manager** – Clicking this button opens the Hardware Manager dialog.

Serial Communications - provides serial data settings
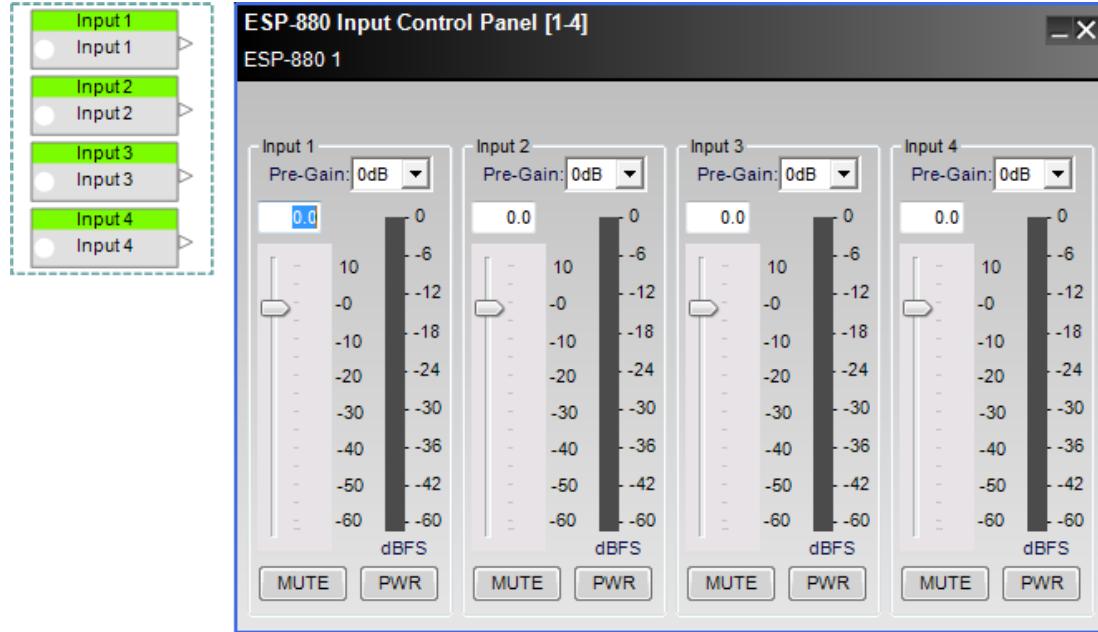
> **Enable Serial over IP** - Check the box to enable serial communication over IP

> **Port Number** - Current serial communications port number.

Fixed ESP Input Controls

Adjustable input controls are accessed by double clicking on any one of the grouped input blocks within the **ESP View** to open the control panel.

Each input control panel displays the controls for the four input channels associated with the input group.

ESP-880 Input Control Panel

The **Input Control Panel** provides the following options:

Input 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View of the ESP.

Pre-Gain Control - Allows the selection of a pre-defined amount of analog input gain (0, 14, 24, 32, 44, 54, or 64 dB) applied to the input signal.

Digital Input Gain Text Entry - Allows the entry of the amount of digital gain (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the input signal.

Digital Input Gain Slider - Allows the adjusting of the amount of digital gain (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the input signal.

Input Signal Meter - Displays the current input signal level in dBFS at the input to the DSP. Input meters include a 'peak hold' indicator which is identified by a red line across the meter.
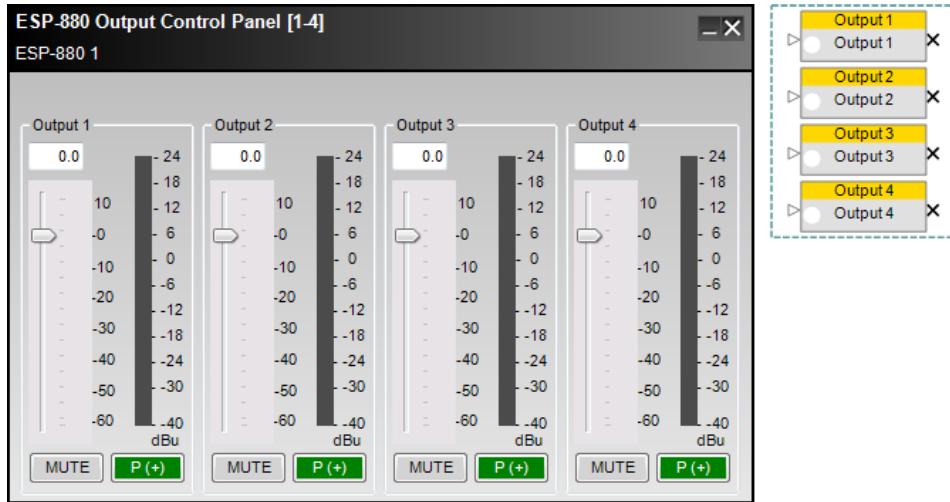
Mute - When selected, mutes the audio signal at the digital input stage.

PWR - When selected, engages the +48V phantom power.

Fixed ESP Output Controls

Adjustable output controls are accessed by double clicking on any one of the grouped output blocks within the **ESP View** to open the control panel.

Each output control panel displays the controls for the four output channels associated with the output group.

ESP-880 Output Control Panel

The **Output Control Panel** provides the following options:

Output 1-4 Label - Displays the channel name as defined by the user within the Signal Processing View.

Digital Output Level Text Entry - Allows the entry of the amount of attenuation (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the output signal.

Digital Output Gain Slider - Allows the adjusting of the amount of attenuation (-60 dB, min, to +12 dB, max, in increments of 0.5 dB) applied to the output signal.

Output Signal Meter - Displays the current output signal level in dBu at the output of the signal processor. Output meters include a 'peak hold' indicator which is identified by a red line across the meter.

Mute - When selected, mutes the audio signal at the digital output stage.
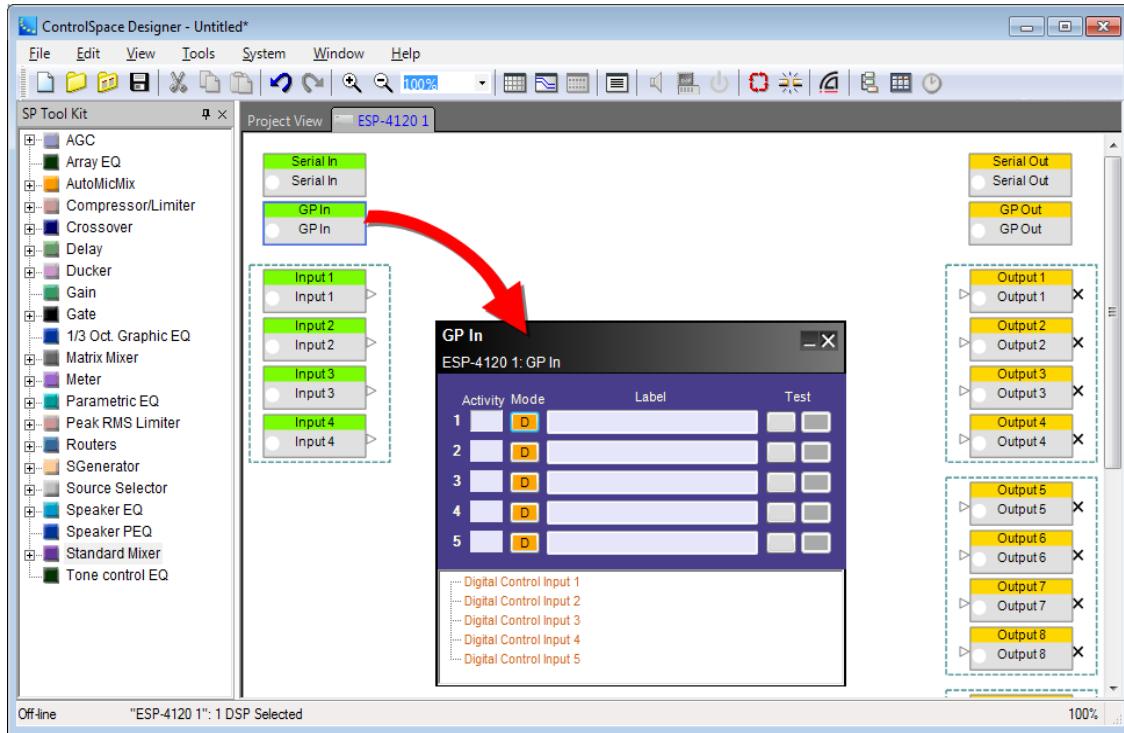
Signal Polarity Control - Reverses the polarity of the signal. Default value is positive (+) or non-inverted. When selected, the signal polarity is negative (-) or inverted, Button color is used to indicate current state with GREEN being non-inverted and RED being inverted.

GPIO (ESP-880/1240/4120/1600)

Fixed-I/O ESPs have 5 General Purpose Control Input (GP In) ports and 5 Control Output (GP Out) ports. GP In ports are used to connect external hardware such as potentiometers (to control levels or gains) and switches (contact closures) to invoke parameter sets. Functions are assigned to these external controls in the **GP In** control panel.

GP In Control Panel

Adjustable input options are accessed by double clicking the appropriate **GP In** block within the **ESP View** to open its control panel.

General Purpose Input (GP In) control panel

Activity - indicators notify the user when a GP input is active. Blue indicates an active input, or when a **Test** button is pressed.

Mode buttons– Determine the operating mode for each general purpose input. Eight input modes are available within each processing block. Left click the operating mode button to toggle through the three supported modes:

Operating Mode	Description
Digital D	Typically used when connecting a switch or push button, this mode expects a normally open switch for operation. Both "on" and "off" actions are supported.
Up/Down ↑ ↓	Up/Down mode uses two adjacent GPI, and is intended to support two push buttons for use as volume up and down. Normally open switches are expected.
Analog A+ A-	Analog mode is intended for a 10 KOhm linear type potentiometer that can be linked to a single or group of gain controls. Select **A+** if the pot measures 0 ohms when fully *counter-clockwise* and 10K ohms when fully *clockwise*. Select **A–** if the pot measures 0 ohms when fully *clockwise* and 10K ohms when fully *counter-clockwise*.

Test buttons - Permit verification of programmed actions for each input. Appearance and function of the test buttons changedynamically with each operating mode.

Operating Mode	Test Operation
Digital D	Single left click per test button activates "on" or "off" conditions.
Up/Down ↑ ↓	Single left click per test button activates "up" or "down" conditions.
Analog A+ A-	Analog mode is intended for a 10 KOhm linear type potentiometer that can be linked to a single or group of gain controls. Select **A+** if the pot measures 0 ohms when fully *counter-clockwise* and 10K ohms when fully *clockwise*. Select **A−** if the pot measures 0 ohms when fully *clockwise* and 10K ohms when fully *counter-clockwise*.
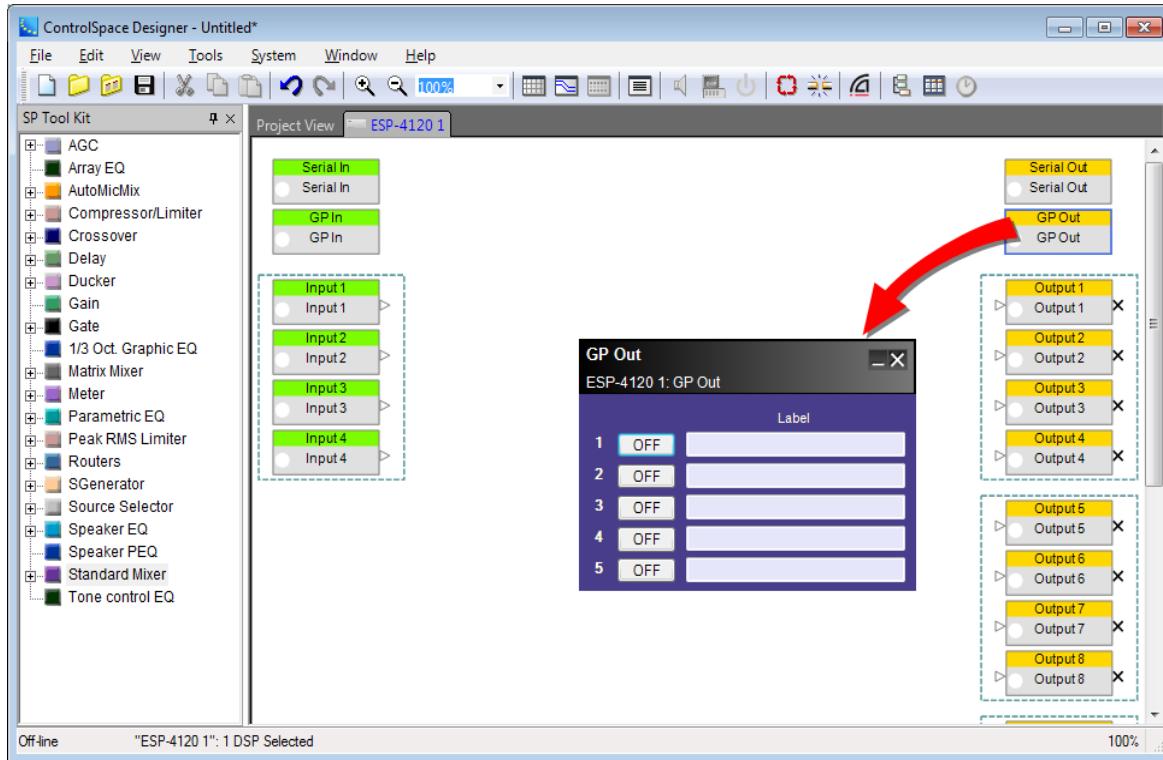
Labels - are user-definable in the properties window.

The lower section of the control panel provides a programming tree to assign functions invoked by the eight General Purpose Inputs. You can drag and drop signal processing blocks, parameter sets, or groups onto the text lines.

See Programming GPIO for programming examples.

GP Out Control Panel

Output functions are accessed by double clicking the appropriate **GP Out** block within the **ESP View** to open its control panel.

Buttons 1-5 correspond to the state of each individual general purpose output port. Click a button to set the state of an output to OFF (default) or ON before assigning the GPO processing block in ESP View to a location in the Project Directory or Parameter Set Nodes List.
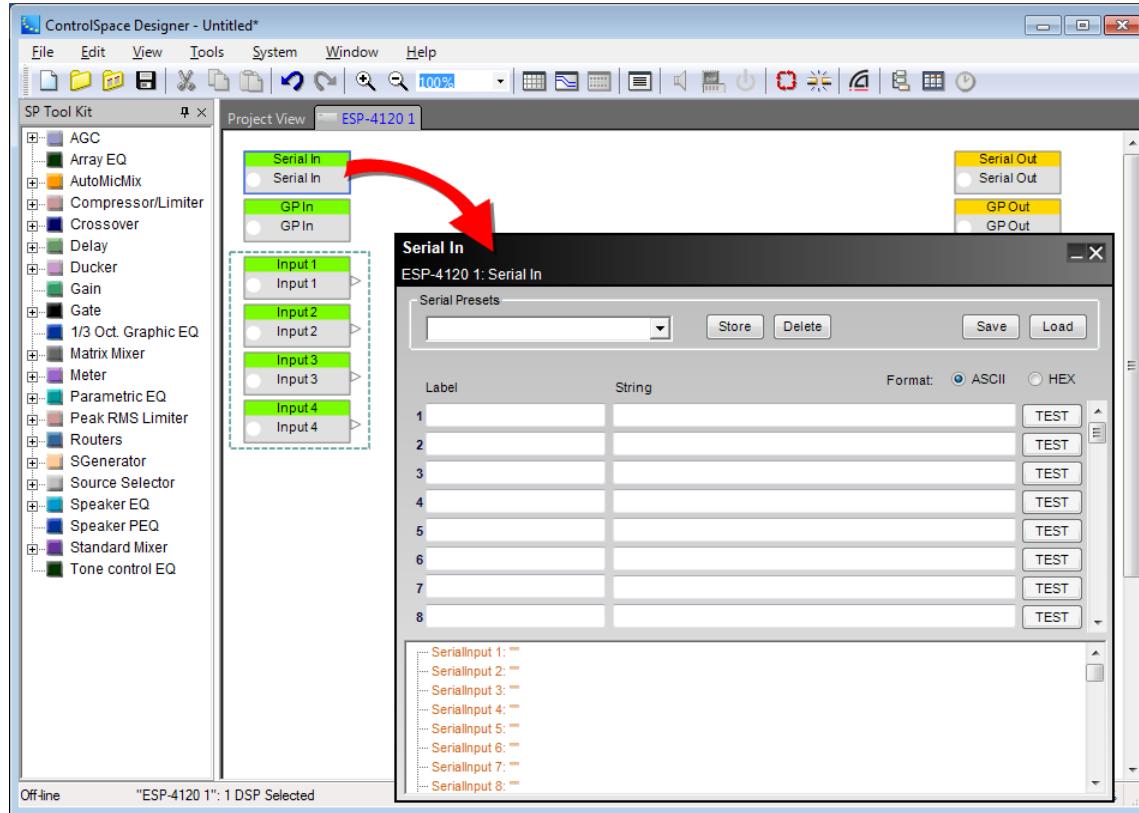
General Purpose Output (GP Out) control panel

See Programming GPIO for programming examples.

Serial In/Out (ESP-880/1240/4120/1600)

Serial Command Support for ESP-880/1240/4120/1600 processors is provided via the integral serial port on the rear I/O panel of an ESP and by a built-in serial command protocol (See application note ControlSpace Serial Protocol v4.3). Up to 64 serial input or output strings are supported. Double-click on the Serial Input or Serial Output blocks in ESP View to open their control panels.

Serial Input

Serial Input processing block and control panel

The **Serial Input control panel** provides the following options:

Serial Presets - allow the user to create "snapshots" of serial settings. The snapshot can then be exported as a "serial preset file" for future use, and used to build a serial preset file. These items behave identically to the Parametric EQ presets list.

Store - commits the current preset settings to memory. Snapshot names and settings become part of the design file when saved to disk.

Delete - removes the currently selected snapshot from the drop down list but retains the preset settings until a new snapshot is selected.

Save - exports the selected preset to a user-specified location on a hard drive.

Load - uploads a selected preset file

Label – used for entering a label to keep track of the serial **String**.

String – provides a location to store up to 64 ASCII characters or 64 HEX characters to match commands received from external devices via the RS-232 serial port. Matching commands received within the serial data stream perform actions specified in the programming tree.

Format:

ASCII/HEX– radio buttons determine the unit scale for text entry. Select ASCII for traditional alpha-numeric character entry or HEX to convert notation to two-bytes per character.

TEST - allows the user to test the programming for a specified serial string. If no target is assigned to the serial string, the "TEST" control is disabled. Serial output TEST controls are only active when online.

Serial Input Programming Tree– provides a drag-n-drop area for assigning ESP functions to perform (block values or parameter sets) when matching serial strings arrive at the serial input.

NOTE: An ESP automatically assumes each input string terminates with one carriage return (CR). You must program the sending equipment to terminate the serial string with one CR at the end of each command. It is unnecessary to include this CR in the Serial Input entry windows.

Serial Output

Serial output processing block and control panel

The **Serial Output control panel** provides the following options:

Serial Presets - allow the user to create "snapshots" of serial settings. The snapshot can then be exported as a "serial preset file" for future use, and used to build a serial preset file. These items behave identically to the Parametric EQ presets list.

Label – used for entering a label to keep track of the serial **String**.

String – provides a location to store up to 64 ASCII characters or 64 HEX characters to match commands received from external devices via the RS-232 serial port. Matching commands received within the serial data stream perform actions specified in the programming tree.

Format:

ASCII/HEX– radio buttons determine the unit scale for text entry. Select ASCII for traditional alpha-numeric character entry or HEX to convert notation to two-bytes per character.

TEST -provides the facility to test actions specified in the programming treefor a serial input as if those values just arrived within the serial data stream.

NOTE: Use hex notation when designating a control character like CR or LF. To designate a hex character, use backslash 0, then the hex value of the character (0-F).

Expansion Cards
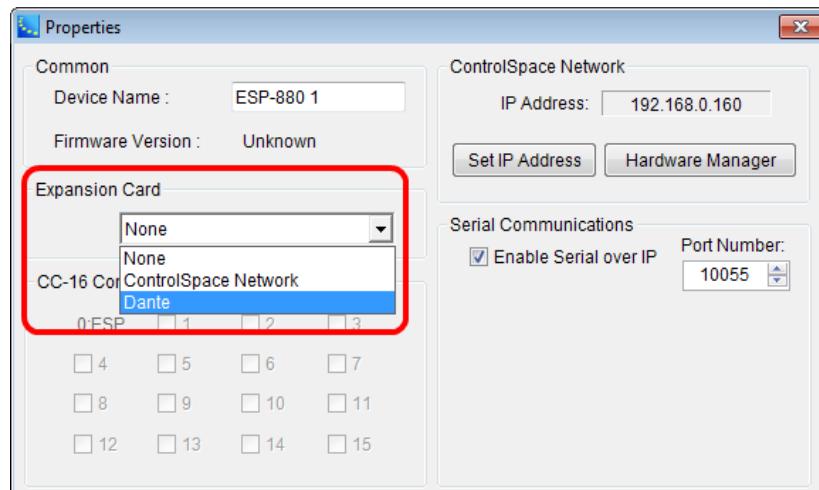
Dante™ Network Card

The Bose ESP-880/1240/4120/1600 engineered sound processors are capable of supporting up to 32 channels of high quality, uncompressed digital audio from a Dante digital audio network in a 16x16 or 32x32 configuration.

Defining the Dante™ Card Configuration

The Dante digital audio network card is added to the ESP-880/1240/4120/1600 in the same manner as other expansion cards. If the card has already been fitted, it will be detected automatically when a hardware scan is performed. Otherwise, the card can be added manually to the system design as follows:

Right-click on the ESP-880/1240/4120/1600 icon in Project View and select Properties to display the ESP-880/1240/4120/1600 Properties dialog box. Then select the Dante option from within the Expansion Card drop-down list.
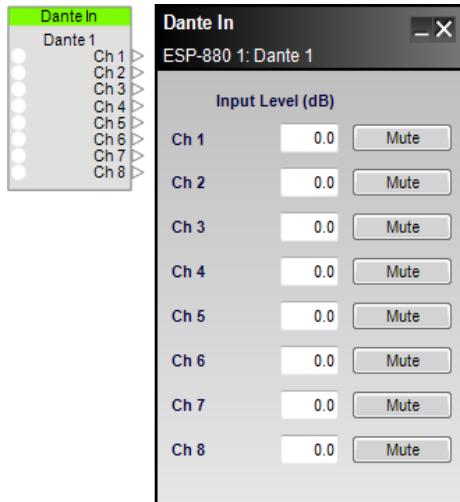
Dante Digital Audio Network Card option within ESP-880/1240/4120/1600 Properties

For information on the Dante global properties control panel, "Dante™ Network Card Properties" on page 351.

Dante Network Card Input/Output Control

The Dante digital audio network cards offer a basic set of input and output controls which can be accessed by double-clicking on the Dante input/output processing blocks.

The input controls of the Dante card are accessed by double clicking on the appropriate Dante input block within the Signal Processing View of the ESP.

Eight-channel Dante network card input control panel

Each eight-channel Dante input control panel provides the following controls:

Input Level (dB) – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain. Type a value directly into the input level box or right-click on the field to access a gain slider.

Mute – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

The output controls of the Dante card are accessed by double clicking on the appropriate Dante output block within the Signal Processing View of the ESP.

Eight-channel Dante network card output control panel

Each eight channel output control panel provides the following controls:

Output Level (dB) – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dBu. This adjustment point is in the digital domain. Type a value directly into the output level box or right-click on the field to access a gain slider.

Polarity – applies a reversal of polarity to the output signal. When Polarity is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and a minus (−) sign is present.

Mute – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

NOTE: For more information on configuring Bose professional system electronics for use with Dante digital audio network audio, refer to the Dante application notes available at http://pro.Bose.com.

ControlSpace® Network Control Card
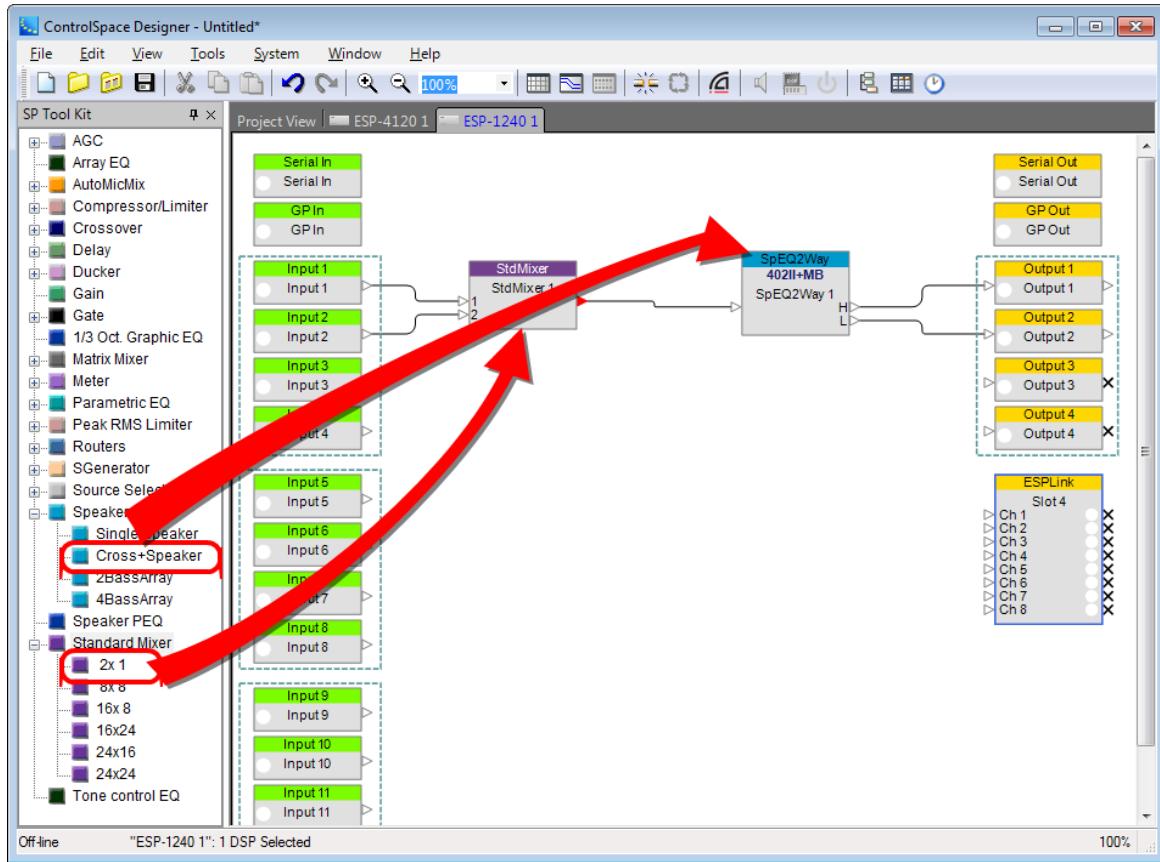
The ControlSpace® Network Control Card adds a rear panel network connection to single-rack ControlSpace ESP processors. With this card a network connection can be made on the rear panel but it also allows network passthrough from the front-panel RJ-45 port.

Signal Processing (SP)

SP Tool Kit

The **Signal Processing (SP) Tool Kit** contains all the signal processing blocks available for use in system designs. The SP Tool Kit window is visible when you are working in **ESP View**. To add signal processing functions, simply drag a block from the SP Tool Kit window and drop it into the ESP View.
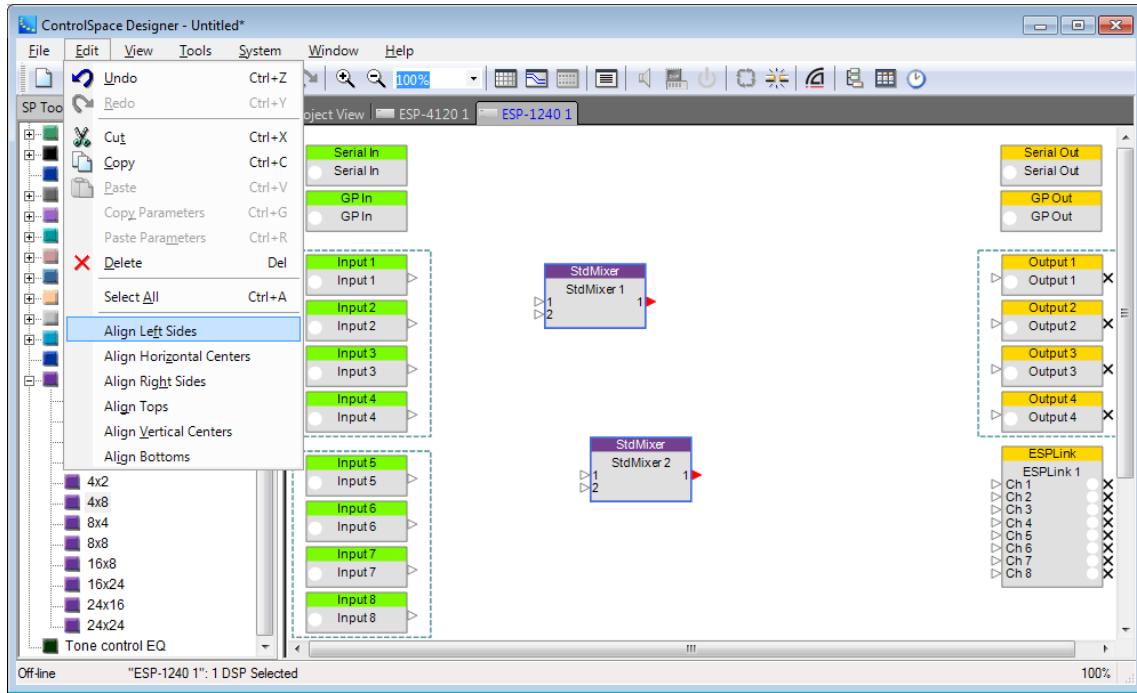
Adding signal processing

Signal processing blocks are grouped by type. Click on the "+" next to a group in the SP Tool Kit to view more signal processing blocks. To open the control panel for any signal processing block, double-click on the block after you have added it to the **ESP View**.

Working With SP Blocks

After dropping signal processing blocks into the **ESP View**, you can move one or more blocks around by selecting and dragging them with the mouse. You may also use the arrow keys on your keyboard to nudge the blocks into position.

To line up blocks, use the options in the **Edit menu**. For example, to vertically align the left borders of a group of blocks, select all the blocks and choose **Edit > Align Left Sides**:
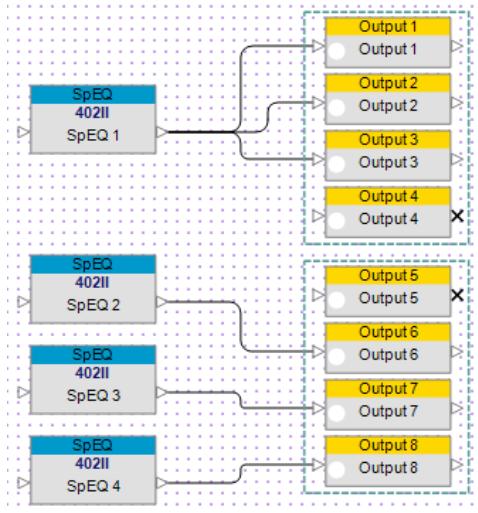
Aligning left sides

NOTE: See the Edit Menu for additional alignment options.

Wiring Blocks
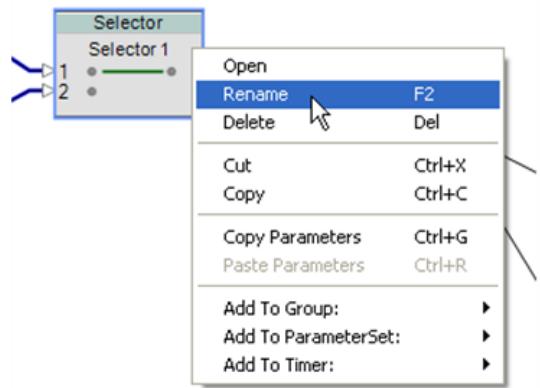
The output of a signal processing block can be wired to more than one input, but the ControlSpace® Designer™ software does not allow a signal processing block to accept more than one input.

Wiring Signal Processing Blocks

Renaming Blocks

To rename any signal processing block, right-click on the block and select Rename, or press F2.
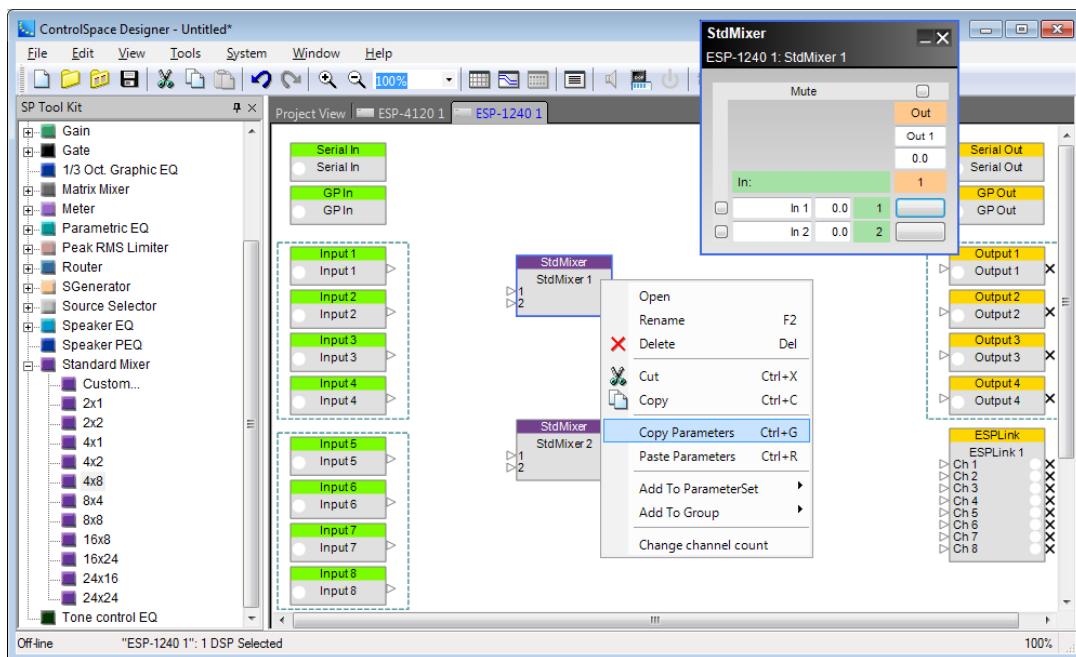
Renaming a signal processing block
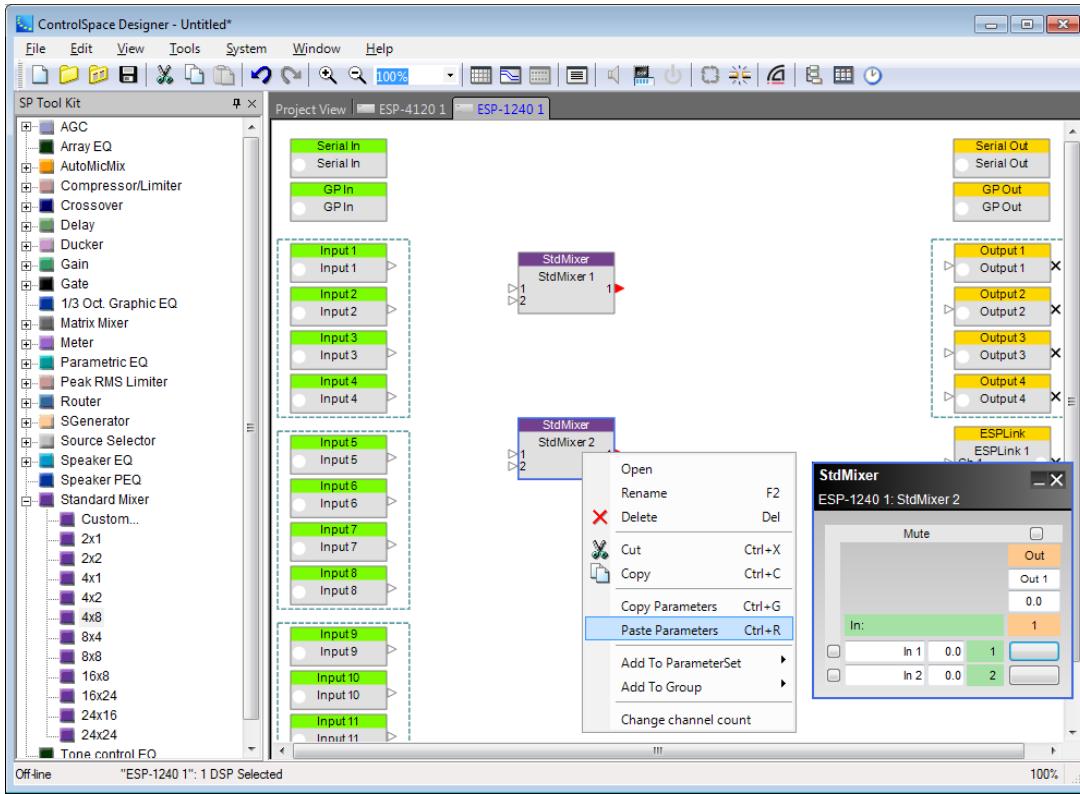
Copy Parameters

To copy the parameters from one signal processing block to another signal processing block of the same kind:

1. Right-click on the signal processing block and select **Copy Parameters**.
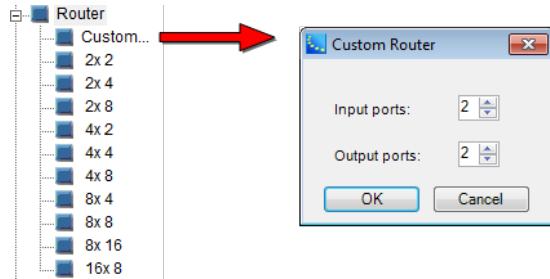
2. Right-click on the other signal processing block of the same kind and select **Paste Parameters**.
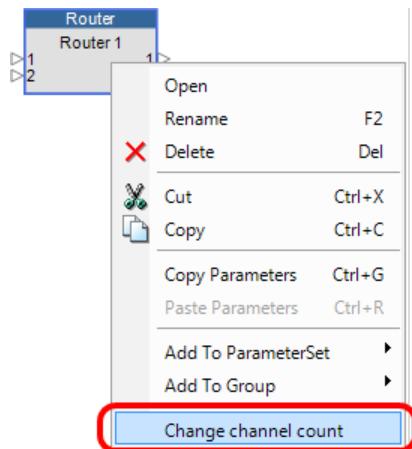
Working with User-Defined Controls

The **Custom** option in the list of block sizes for Matrix Mixers, Standard Mixers, Routers, Source Selectors, and Gain blocks allows you to set up any block size you prefer rather than use a predefined size from the default list of options. When dragging a Custom block into the device view, you will be prompted with a dialog asking for the desired number of input and output ports.
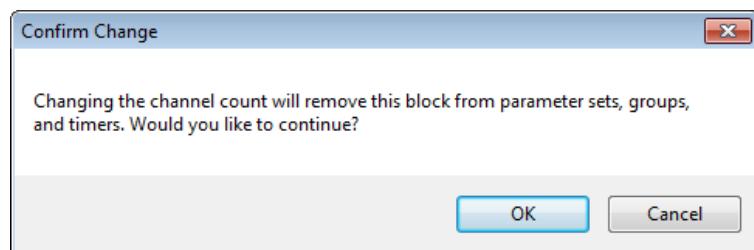
Example of user-defined controls
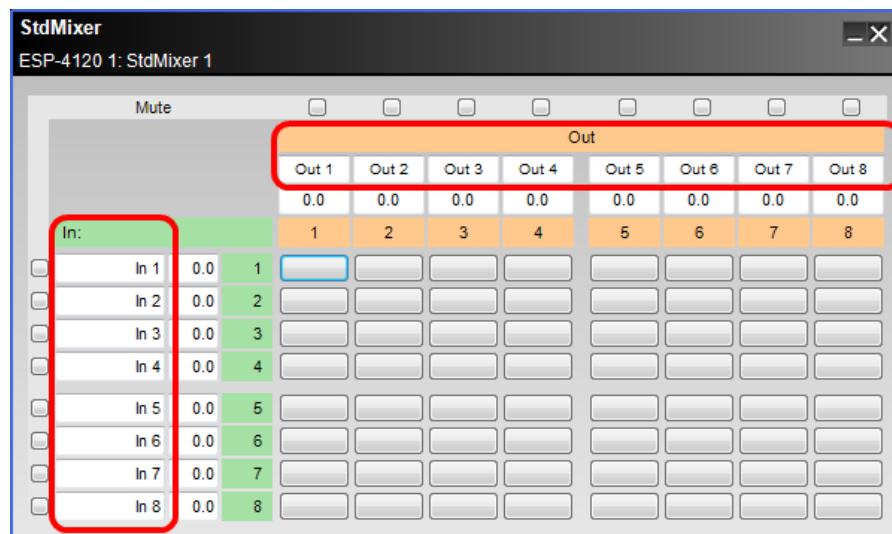
In addition, any existing Matrix Mixers, Standard Mixers, and Routers can be re-sized by selecting **Change channel count** in the right-click menu, but only while the device is offline. Gain blocks cannot be re-sized.

If a block is re-sized, it will be cleared from any programming (parameter sets, groups, and timers). If a block is in programming when you attempt to re-size it, you will be warned before completing the action. From here, the you may click **OK** to continue with the re-sizing of the block, or back out of it by clicking **Cancel**.

Input and output channels in Standard Mixers and Matrix Mixers can be given custom labels. These can be edited by double-clicking the block and using the mixer's form. The labels are located at the left (input) and top (output) of the form.

Supported SP Algorithms

SP Blocks
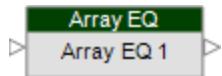
The **SP Tool Kit** contains the all the signal processing blocks available for use in a system design. The SP Tool Kit is visible any time you are working within ESP View as a vertically scrolling pane on the left hand of the design interface.

Type	Selections
AGC	monaural/stereo
AMM - Gain Sharing	NA
AMM - Gated	4x1/6x1/8x1
Array EQ	NA
Compressor/Limiter	monaural/stereo
Crossover	2way/3way/4way
Delay	1 out/2 out/4 out/8-out
Ducker	monaural/stereo
Gain	Custom/1x1/2x2/4x8/8x8
Gate	monaural/stereo
1/3 Oct. Graphic EQ	NA
Matrix Mixer	Custom/2x2/2x4/4x2/4x4/4x8/8x2/8x4/8x8/8x16/16x8/16x16
Meter	4/8/16
PEQ	Mono-Custom/Stereo-Custom/ Mono-3 band/Mono-5 band/Mono-7 band/Mono-9 band/ Stereo 3-band/Stereo 5-band/Stereo 7-band/Stereo 9-band
Peak RMS Limiter	monaural/stereo
Router	Custom/2x2/2x4/2x8/4x2/4x4/4x8/8x4/8x8/8x16/16x8
SGenerator	Sine Generator/Noise Generator/Sweep Generator
Source Selector	mono-Custom/stereo-Custom/ mono 2/mono 3/mono 4/mono 5/mono 6/mono 7/mono 8/mono 9/mono 10/mono 16/ stereo 2/stereo 3/stereo 4/stereo 5/stereo 7/stereo 8/stereo 16
Speaker EQ	Single Speaker/Cross+Speaker/2BassArray/4BassArray
Speaker PEQ	

Type	Selections
Standard Mixer	Custom/2x1/2x2/4x1/4x2/4x8/8x4/8x8/16x8/16x24/24x16/24x24
Tone Control EQ	

Array EQ

The Array EQ signal processing function provides specialized equalization for RoomMatch® array module loudspeakers. This unique EQ processor may be used as a general purpose room compensation EQ for standard systems.

    Block Label – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Array EQ control panel, double click on its signal processing block in the signal processing view. The default state of the Array EQ is Bypass to provide a flat initial response.

The following controls are available within the Array EQ:

    Filter Display – Displays a graphical representation of array equalization settings in both frequency and level. The line represents the composite frequency response of chosen array and advanced filter parameters.

    Array Parameters – Specifically for use with Progressive Directivity Arrays.

        Module Quantity – Selects the quantity of modules within the array.

        Vertical Coverage – Enters the total vertical angle, in degrees, of the array.

    Advanced (Filter Parameters) – The Array EQ is represented by three basic filter controls: Center Frequency, Tilt, and Gain. Using these controls the basic array preset may be modified, or a new array or room EQ may be created.

Center Frequency – Center frequency of the filter, represented by the dashed line in the Response Graph.

Tilt – Adjusts the start and end points of the filter's slope on either side of the center frequency. Tilt is adjustable between 0 and 10 in steps of 0.3, the greater the tilt the steeper the filter slope.

Gain – Amount of boost or cut applied to the filter below the center frequency. Gain is adjustable in 0.3 dB steps between -12 and +2 dB.

AGC

Automatic Gain Control (AGC) combines a compressor and a gate to maintain a constant output signal level with varying input signal levels. Both a monaural AGC with one input and a stereo AGC with two inputs are supported.

Control panels between mono and stereo versions are similar. The stereo AGC adds a detector drop down list.

Double-click on the AGC block in ESP View to open its control panel.

AGC processing blocks and control panels

The **AGC** control panel provides the following options:

Detector – (stereo only) determines which of the available signal inputs are monitored to trigger the signal processing.

   Left - indicates the left signal is the trigger for processing.

   Right - indicates the right signal is the trigger for processing.

   Mix - indicates a left/right signal mix signal is the trigger for processing.

Threshold slider – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.
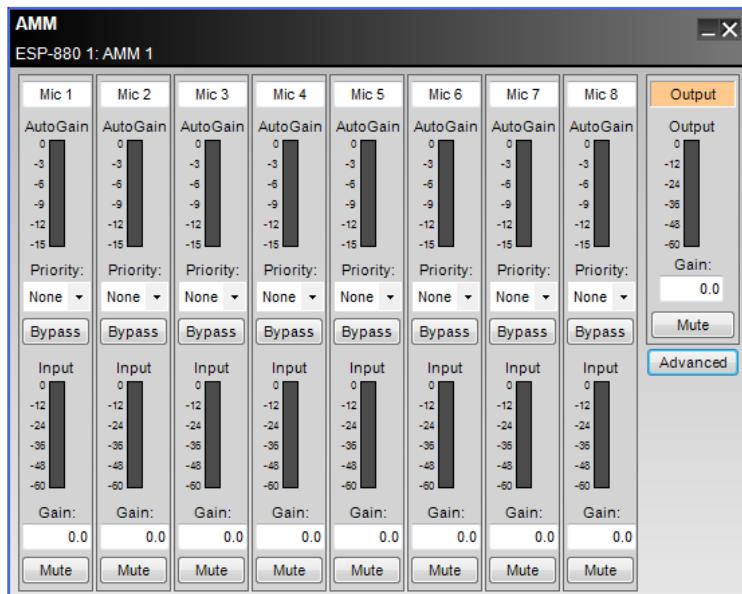
Threshold gain value – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

Reduction graph – displays a vertical bar level indicator to illustrate the amount of signal reduction applied based upon the currently defined processing values.

Bypass – forces the channel to remain open at all times by circumventing the detection circuitry.

Gain Sharing Automatic Microphone Mixer

TBD
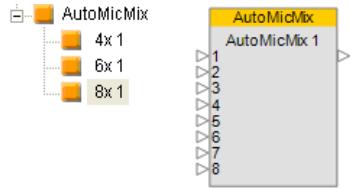
Example: Eight-Channel Gain Sharing AMM

Gated Automatic Microphone Mixer

The Gated Automatic Microphone Mixer manages the signal level from multiple microphones to achieve a constant output level without user intervention.

The automatic microphone mixer (AMM) is available in three configurations: 4x1, 6x1, and 8x1.
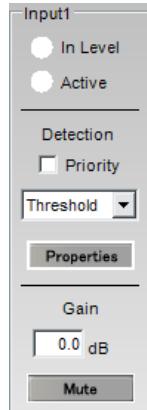
Double click on the AMM block in ESP View to open its control panel.

Automatic 8x1 Microphone Mixer processing block and control panel

The **Automatic Microphone Mixer control panel** provides the following options:

Input – channels are identical in functionality for the 4x1, 6x1, and 8x1 configurations. Each version provides these controls:

AMM input control panel

>   **In Level** – is a three-color status indicator to illustrate the range of the current input signal level. Colors indicate the following input ranges:

>>   Green   > 36 dBFS

>>   Yellow   -20 to -6 dBFS

>>   Red   > -6 dBFS

Active – is a three-color status indicator to illustrate the current input activity of the signal processing block:

White   Off (inactive)

Light Blue   Active

Dark Blue   Active input, but at a reduced level due to a higher priority channel

Detection – settings determine when the input channel turns on automatically.

Priority – check box forces other non-priority input channels to duck or reduce in level when this channel gates on. Multiple input channels can have Priority checked. Any channel with Priority selected will duck "non-priority" channels but will not duck another "Priority" channel.

Threshold – enables a channel gate to open when a predetermined signal level is reached. When the signal drops below this threshold, the channel gate closes once more.
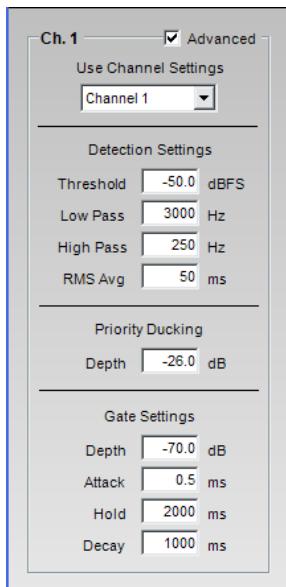
LastOn – allows a channel to remain open even after it falls below the threshold. The channel continues to remain open until another channel becomes active.

PushToTalk – requires a trigger to open the channel. This trigger can be from a control panel push button or from a programmed GPI event.

Bypass – forces the channel to remain open at all times by circumventing the detection circuitry.

Properties – opens an additional control panel to adjust settings for each of the detection methods. Available options within this control panel are:

Advanced – expands the properties available with an additional option for **Detection Settings** and a new section entitled **Gate Settings**.

AMM advanced section of input control panel

Use Channel Settings - applies the settings from a specified channel to the current channel, thereby overriding the current channel settings.

Detection Settings - determine the gating method used for the input channel.

Threshold - default value is -50 dBFS, and the range is from 80 to -50 dBFS.

Low Pass - cut-off frequency default is 20 kHz, and the range is from 300 to 20 kHz.

High Pass - cut-off frequency default is 250 Hz, and the range is 20 to 1 kHz.

RMS Avg – is an advanced setting available only when the **Advanced** check box is active. Value is the length in milliseconds, of the RMS averaging performed on the detection signal chain. The default is 50 ms, and the range is 0 to 500

Priority Ducking – determines the amount of ducking applied to the channel when the priority channel is open. The default is 26.0 dB, and the range is -60.0 to 0.0 dB

Gate Settings - are advanced configuration options available only when the **Advanced** check box is active. Options provided when this window section is visible are:

Depth – is the amount of attenuation applied when the input gate is not open. The default is 70.0 dB, and the range is 70.0 to 0.0 dB

Attack – is the amount of time, in milliseconds, from when the gate is turned on until it is fully open. The default is 0.5 ms, and the range is 0.5 to 100.0

Hold – is the amount of time the gate will remain open once the signal is no longer present. The default is 2000 ms, and the range is 1 to 50,000
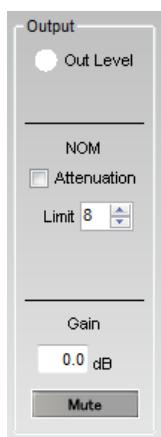
Decay – is the amount of time required for the gate to transition from its open to fully attenuated state. The default is 1,000 ms, and the range is 5 to 50,000

Gain - adjusts the post-gate output level of the input channel.

Gain value – is entered directly into the text box or by right clicking text box to activate a gain slider. The range of adjustment is -∞ to 0 dBFS (default).

Mute - attenuates the input channel. When Mute is enabled, the control panel button is Red.

Output – channel options are common to all versions of AMM. This section of the control panel includes an Output Level indicator, Number of Open

AMM output control panel

Out Level – is a three-color indicator to display the output channel level:

Green   > 36 dBFS

Yellow   -20 to -6 dBFS

Red   > -6 dBFS

NOM – provides options related to the Number of Open Microphones.

Attenuation - activates the NOM attenuation function. This will apply −10*Log(NOM) output attenuation to the channel.

Limit – determines the maximum number of microphones that may be active at any time. The range of values is from 1 to the total number of channels in the selected Automatic Microphone Mixer processing block, 4, 6, or 8.

Note: If the Limit value is less than the number of microphones which are active, the following logic is used to determine which microphones are selected:

Priority – channels meeting all other conditions take precedence over non-priority channels.

First-come, first-served – activates channels in the order that required conditions are met and held.
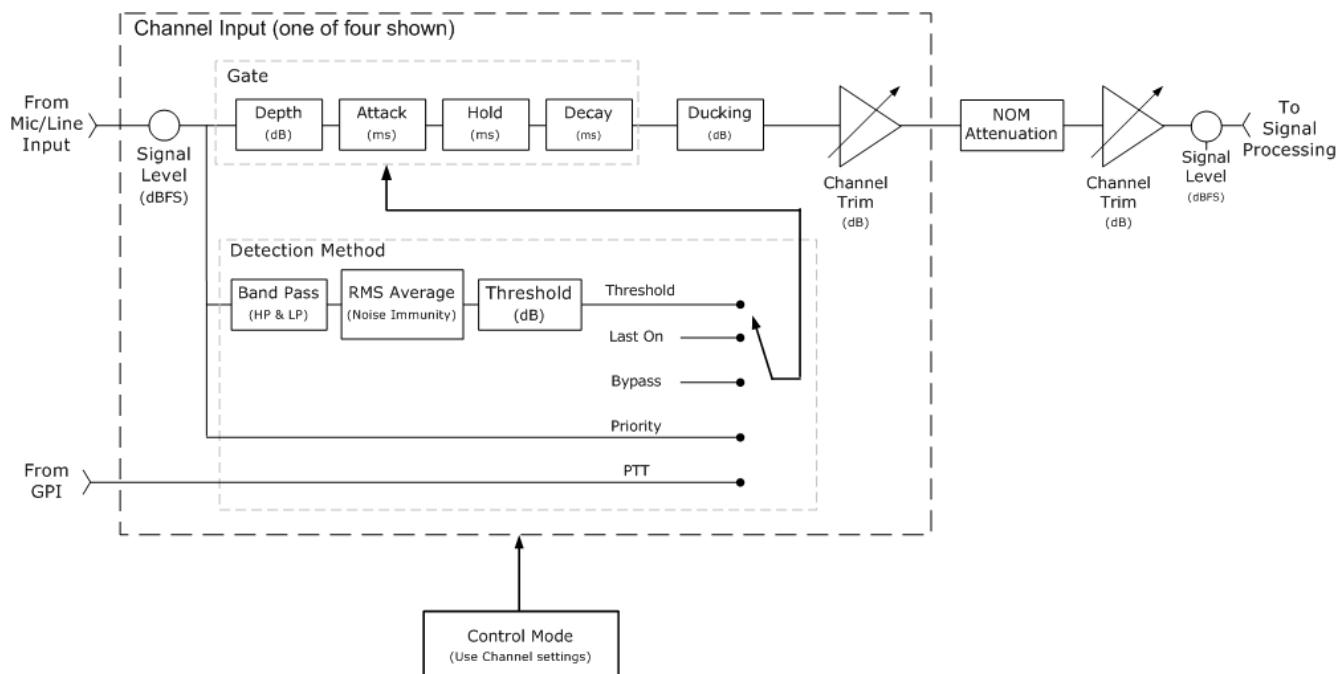
Lowest-numbered channel – activates sequentially starting with the smallest numerically valued channel and in ascension thereafter until the NOM limit is reached.

Gain - adjusts the overall output level of the Automatic Microphone Mixer block.

Gain value – is entered directly into the text box or by right clicking text box to activate a gain slider. The range of adjustment is -∞ to 0 dBFS (default).

Mute - attenuates the output channel. When Mute is enabled, the control panel button is Red.

The following **Automatic Microphone Mixer** functional diagram helps to illustrate the signal flow and logic operations of this signal processing block:
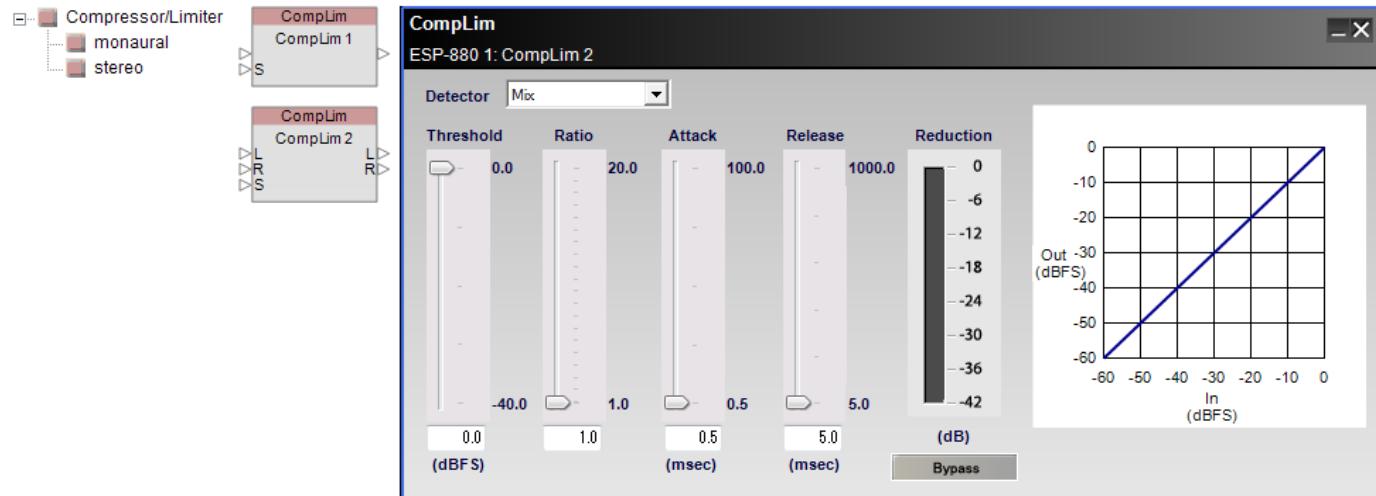
Automatic Microphone Mixer Functional Diagram

Compressor/Limiter

Compressor/Limiter processing reduces the level of an input signal when it reaches a predetermined threshold. Both a monaural Compressor/Limiter with one input and a side chain input, and a stereo Compressor/Limiter with stereo inputs and a side chain input are supported.

Control panels between mono and stereo versions differ only in the choice of input trigger signals.

Double-click on the Compressor/Limiter block in ESP View to open its control panel.

Stereo Compressor/Limiter, processing block and control panel

The **Compressor/Limiter** control panel provides the following options:

> **Detector** – determines which of the available signal inputs are monitored to trigger the signal processing.

>> **Left -** (stereo only) indicates the left signal is the trigger for processing.

>> **Right -** (stereo only) indicates the right signal is the trigger for processing.

>> **Mix -** (stereo only) indicates a left/right signal mix is the trigger for processing.

>> **Side chain -** indicates the side chain input is the trigger for processing.

> **Threshold slider** – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

> **Threshold gain value** – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

> **Ratio slider** – establishes an input/output ratio for signals above the threshold. Signals exceeding the input threshold are reduced by an amount according to the ratio, e.g., a signal ten times greater than the threshold signal value (10:1) results in a processing stage output at 1 dB above the threshold value.

> **Ratio value** – is entered directly into the text box. The range of adjustment is 1.0 (default) to ∞ and tracks the threshold slider setting.

> **Attack slider** – establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

Attack value – is entered directly into the text box. The range of adjustment is from 0.5 milliseconds (default) to 100 milliseconds.

Release slider – determines the rate in milliseconds when signal processing is discontinued after threshold is exceeded.

Release value – is entered directly into the text box. The range of adjustment is from 5 milliseconds (default) to 1000 milliseconds.

Reduction graph – displays a vertical bar level indicator to illustrate the amount of signal reduction applied based upon the currently defined processing values.

Bypass – forces the channel to remain open at all times by circumventing the detection circuitry.
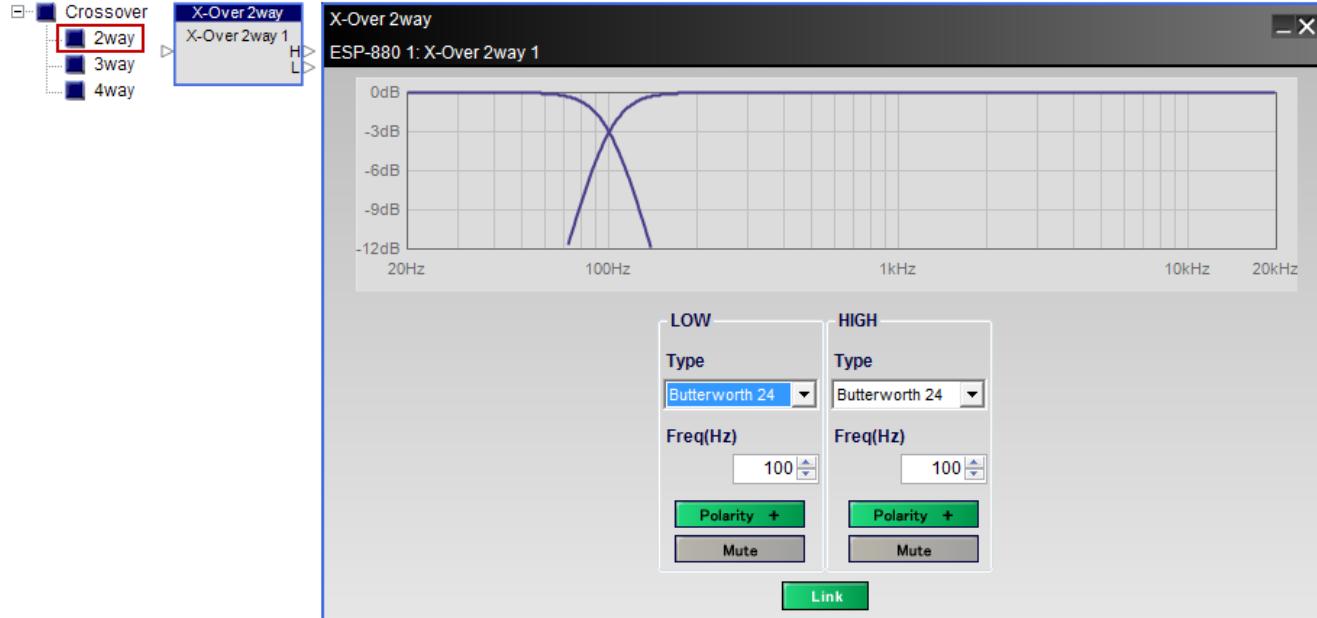
Compressor/Limiter graph - illustrates the input level versus the output level of the signal in a graphical manner. The slope of the line indicates the compression ratio.

Crossover

A crossover divides an input signal into two or more frequency ranges, and sends each frequency range to a separate output. The SP Tool Kit includes a 2-way, 3-way, and 4-way processing block.

2-way crossover

A 2-way crossover divides an input signal into two frequency ranges, high and low, and sends these signals to two outputs marked H (high) and L (low). Double-click on the 2 way crossover block within ESP View to open its control panel.

2 way crossover, processing block and control panel

The **2 way crossover control panel** provides the following options:

Crossover Graph – displays a graphical representation of adjustable crossover filter settings in both frequency and level. The line to the left represents the low frequency output level and the line to the right represents the high frequency output level.

LOW – adjusts the low frequency filter parameters.

Type – determines the filter parameters used for the crossover.
Options include:

Type	Slope	Type	Slope	Type	Slope
Butterworth 6	6 dB/oct				
Butterworth 12	12 dB/oct	Bessel 12	12 dB/oct		
Butterworth 18	18 dB/oct	Bessel 18	18 dB/oct	Linkwitz-Riley 12	12 dB/oct
Butterworth 24	24 dB/oct	Bessel 24	24 dB/oct	Linkwitz-Riley 24	24 dB/oct
Butterworth 36	36 dB/oct	Bessel 36	36 dB/oct	Linkwitz-Riley 36	36 dB/oct
Butterworth 48	48 dB/oct	Bessel 48	48 dB/oct	Linkwitz-Riley 48	48 dB/oct

Freq(Hz) – provides and input box for entry of a specific crossover filter frequency (default = 100Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

Polarity – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and a minus (-) sign is present.

Mute – silences the effect of the filter. When Mute is enabled, the control panel button is Red.

HIGH – adjusts the high frequency filter parameters.

Type – determines the filter parameters used for the crossover.
Options are identical to low frequency filter parameters.

Freq(Hz) – provides and input box for entry of a specific crossover filter frequency (default = 100Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

Polarity – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and aminus (-) sign is present.

Mute – silences the effect of the filter. When Mute is enabled, the control panel button is Red.

Link - locks the low pass and high pass frequencies to the same number. This is only an option when both the low and high types are set to Butterworth or Linkwitz-Riley. If link is off, the low pass and high pass frequencies can be adjusted independently.

3-way crossover

A 3-way crossover divides an input signal into three frequency ranges, high, low mid, and low, and sends these signals to three outputs marked H (high), M (mid), and L (low). Double-click on the 3 way crossover block within

ESP View to open its control panel.

3 way crossover, processing block and control panel

The **3 way crossover control panel** provides all the options of the 2 way crossover plus:

   LOW MID – adjusts the mid frequency filter parameters.

   Type – determines the filter parameters used for the crossover. Two sets of Type options are available to represent each end of the filter spectrum. Options include:

Type	Slope	Type	Slope	Type	Slope
Butterworth 6	6 dB/oct				
Butterworth 12	12 dB/oct	Bessel 12	12 dB/oct		
Butterworth 18	18 dB/oct	Bessel 18	18 dB/oct	Linkwitz-Riley 12	12 dB/oct
Butterworth 24	24 dB/oct	Bessel 24	24 dB/oct	Linkwitz-Riley 24	24 dB/oct
Butterworth 36	36 dB/oct	Bessel 36	36 dB/oct	Linkwitz-Riley 36	36 dB/oct
Butterworth 48	48 dB/oct	Bessel 48	48 dB/oct	Linkwitz-Riley 48	48 dB/oct

   Freq(Hz) – provides and input box for entry of a specific crossover filter frequency (default = 100Hz and 1000Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

   Polarity – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and aminus (-) sign is present.

   Mute – silences the effect of the filter. When Mute is enabled, the control panel button is Red.

4-way crossover

A 4-way crossover divides an input signal into four frequency ranges, high, high mid, low mid, and low, and sends these signals to four outputs marked H (high), HM (high mid), LM (low mid), and L (low).

4 way crossover, processing block and control panel

The **4 way crossover control panel** provides all the options of the 3 way crossover plus:

HIGH MID – adjusts the mid frequency filter parameters.

Type – determines the filter parameters used for the crossover. Two sets of Type options are available to represent each end of the filter spectrum. Options include:

| Type	Slope	Type	Slope	Type	Slope
Butterworth 6	6 dB/oct				
Butterworth 12	12 dB/oct	Bessel 12	12 dB/oct		
Butterworth 18	18 dB/oct	Bessel 18	18 dB/oct	Linkwitz-Riley 12	12 dB/oct
Butterworth 24	24 dB/oct	Bessel 24	24 dB/oct	Linkwitz-Riley 24	24 dB/oct
Butterworth 36	36 dB/oct	Bessel 36	36 dB/oct	Linkwitz-Riley 36	36 dB/oct
Butterworth 48	48 dB/oct	Bessel 48	48 dB/oct	Linkwitz-Riley 48	48 dB/oct

Freq(Hz) – provides and input box for entry of a specific crossover filter frequency (default = 1000Hz and 10000Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

Polarity – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a plus (+) sign is present. When Polarity is reversed, the control panel button is Red and aminus (-) sign is present.

Mute – silences the effect of the filter. When Mute is enabled, the control panel button is Red.

Delay

Delay blocks introduce adjustable signal delays configurable for one, two, four, and eight outputs. Delay values are independently adjustable per output. Double click on a Delay block in ESP View to open its control panel.

Four channel delay processing block and control panel

The **Delay control panel** provides the following options:

Units – define the numbering system and scale for a desired delay value. Supported units are:

Milliseconds (0-1000 ms)

Sample (0-48,000 samples)

Meter (0-343.7 m)

Millimeter (0-343,700 mm)

Feet (0-1127.625 ft)

Inch (0-13,531.496 in)

Output Delay – adjusts the signal delay delivered to the next gain stage. The range of adjustment varies according to the units chosen. This adjustment point is in the digital domain.

Bypass – buttons remove individual delays from the signal chain. When bypass is active, the button turns "Green." When inactive, the button is "Gray."
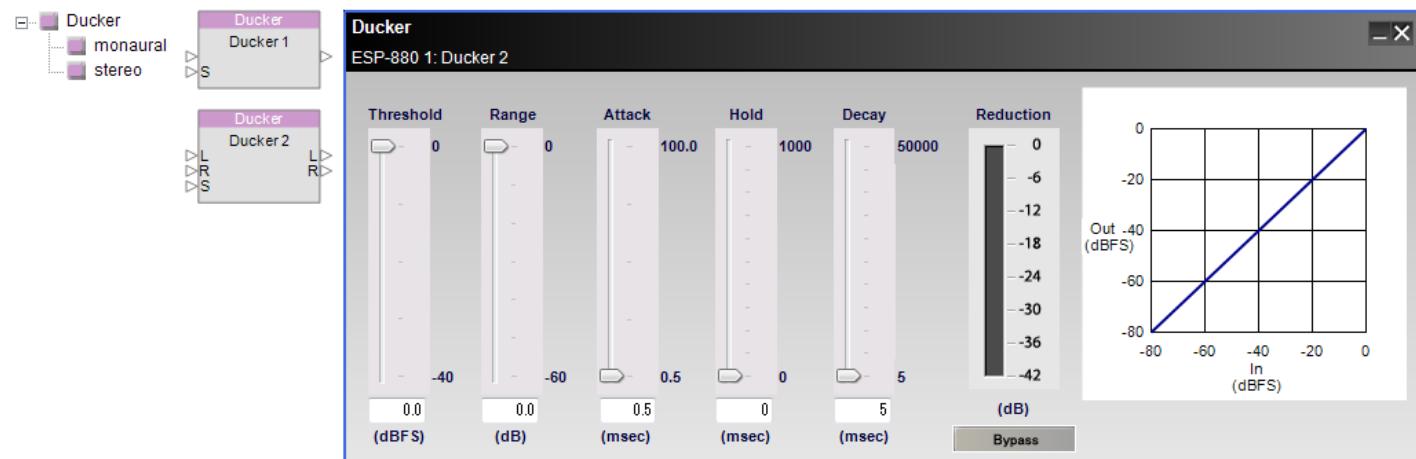
Ducker

The Ducker reduces the level of an input signal when a signal is present on the side chain input. Both a monaural Ducker with one input and a side chain input, and a stereo Ducker with stereo inputs and a side chain input are

supported.

Control panels between mono and stereo versions are identical.

Double-click on the Ducker block in ESP View to open its control panel.

Ducker processing blocks and control panel

The **Ducker** control panel provides the following options:

Threshold slider – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

Threshold gain value – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

Range slider – dictates the amount of reduction in volume when the ducker is active.

Range value – is entered directly into the text box. The range of adjustment is -60 to 0 dB (default) and tracks the range slider setting.

Attack slider – establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

Attack value – is entered directly into the text box. The range of adjustment is from 0.5 milliseconds (default) to 100 milliseconds.

Hold slider – determines the length in time (milliseconds) when the input signal is held in a ducked state.

Hold value – is entered directly into the text box. The range of adjustment is from 0 milliseconds (default) to 1000 milliseconds.

Decay slider – establishes the rate in milliseconds at which input signals are returned to their normal level from a ducked state.

Decay value – is entered directly into the text box. The range of adjustment is from 5 milliseconds (default) to 50000 milliseconds.

Reduction graph – displays a vertical bar level indicator to illustrate the amount of signal reduction applied based upon the currently defined processing values.

Bypass – forces the channel to remain open at all times by circumventing the detection circuitry.
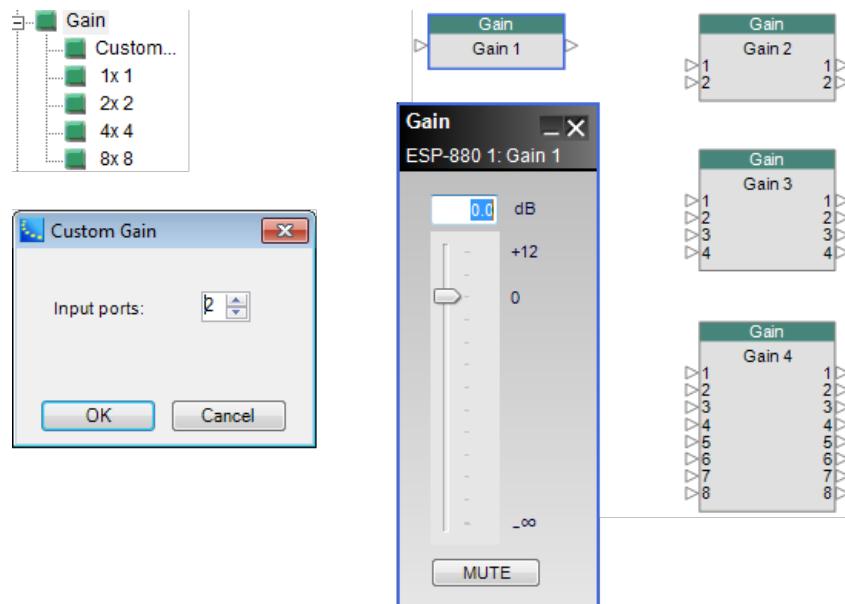
Ducker graph - illustrates the input level versus the output level of the signal in a graphical manner.

Note: The side chain input signal is only used as a trigger signal, it is not passed to the ducker output. To hear this signal, you must mix it back in to the signal chain along with the Ducker output.

Gain

Gain blocks provide a convenient method to add individual gain control points within a system design. These blocks use the fewest CPU resources of any other signal processing element and are helpful in many applications. Standard gain blocks are available in one, two, four, and eight channel blocks. The Custom Gain option allows you to create a gain block that meets your needs. Double-click on a gain block in ESP View to open its control panel.

For more details on Custom Gain blocks, see "Working with User-Defined Controls" on page 165.

Gain processing blocks and control panel

The **Gain control panel** provides the following options:

Gain Value – permits direct text entry of desired input signal level in dB. Range of adjustment matches and tracks the input gain slider.

Gain Slider – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dB.
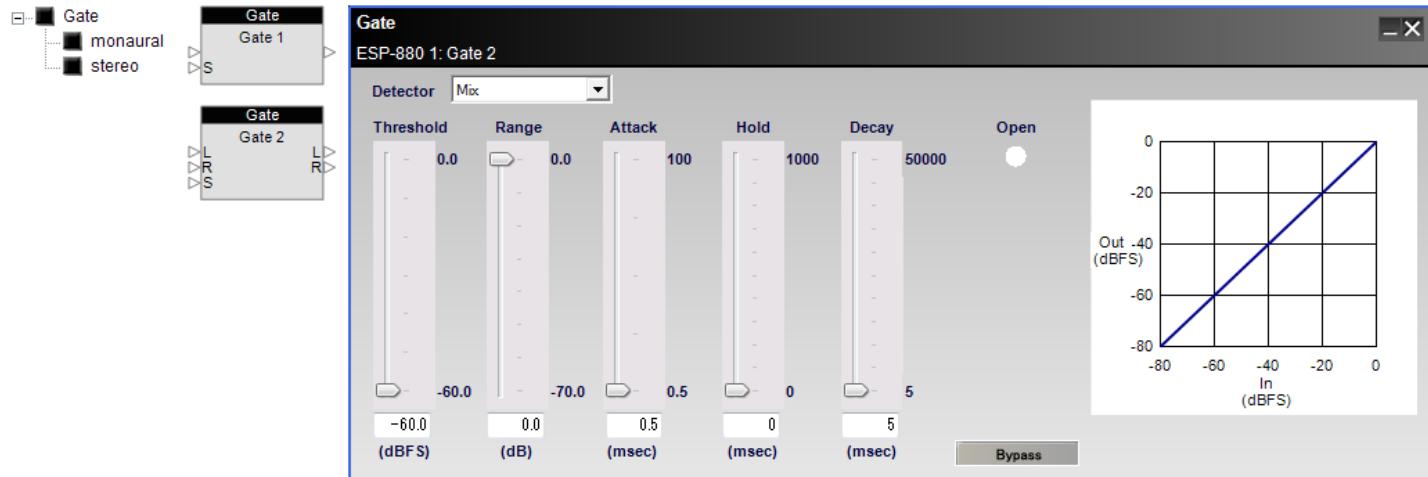
Mute – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

Gate

Gate attenuates input signals below the designated threshold. Both a monaural Gate with one input and a side chain input, and a stereo Gate with stereo inputs and a side chain input are supported.

Control panels differ only in the choice of input signal used as the trigger signal.

Double-click on the Gate block in ESP View to open its control panel.

Gate processing blocks and control panel for stereo gate

The **Gate** control panel provides the following options:

Detector – (stereo only) determines which of the available signal inputs are monitored to trigger the signal processing.

> **Left -** indicates the left signal is the trigger for processing.
>
> **Right -** indicates the right signal is the trigger for processing.
>
> **Mix -** indicates a left/right signal mix is the trigger for processing.
>
> **Side chain -** indicates the side chain input is the trigger for processing.

Threshold slider – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

Threshold gain value – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

Range slider – dictates the amount of reduction in volume when the Gate is active.

Range value – is entered directly into the text box. The range of adjustment is -70 to 0 dB (default) and tracks the range slider setting.

Attack slider – establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

Attack value – is entered directly into the text box. The range of adjustment is from 0.5 milliseconds (default) to 100 milliseconds.

Hold slider – determines the length in time (milliseconds) when the input signal is held in a gated on state.

Hold value – is entered directly into the text box. The range of adjustment is from 0 milliseconds (default) to 1000 milliseconds.

Decay slider – establishes the rate in milliseconds at which input signals are returned to their normal level from a gated on state.

Decay value – is entered directly into the text box. The range of adjustment is from 5 milliseconds (default) to 50000 milliseconds.
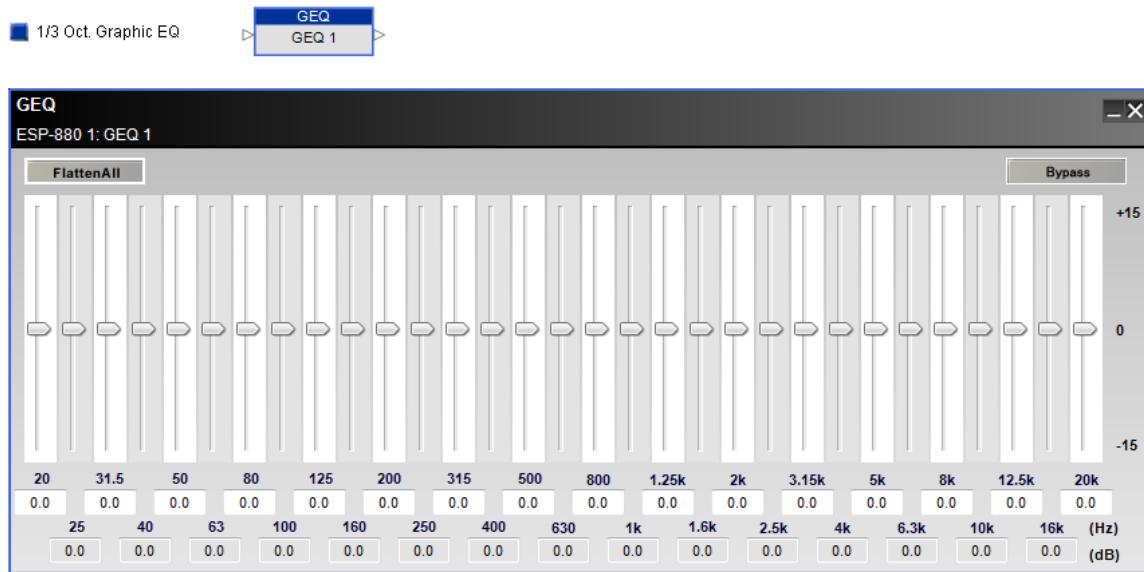
Open – is an indicator to illustrate signal is passing through the gate to its output. When the gate is closed and no signal is passing, the indicator is White. When the gate is open and signal is passing, the indicator is Blue.

Bypass – forces the channel to remain open at all times by circumventing the detection circuitry.

Gate graph - illustrates the input level versus the output level of the signal in a graphical manner. The line represents the effect of the gate processing values.

1/3 Oct Graphic EQ

The 1/3 Oct Graphic EQ boosts or cuts the output level at 31 different frequencies and at 1/3 octave intervals from 20 Hz to 20 kHz. Double-click on the 1/3 Oct Graphic EQ block in ESP View to open its control panel.

1/3 Oct Graphic EQ, processing block and control panel.

The **1/3 Oct Graphic EQ control panel** provides the following options:

Flatten All – resets all gain sliders to zero.
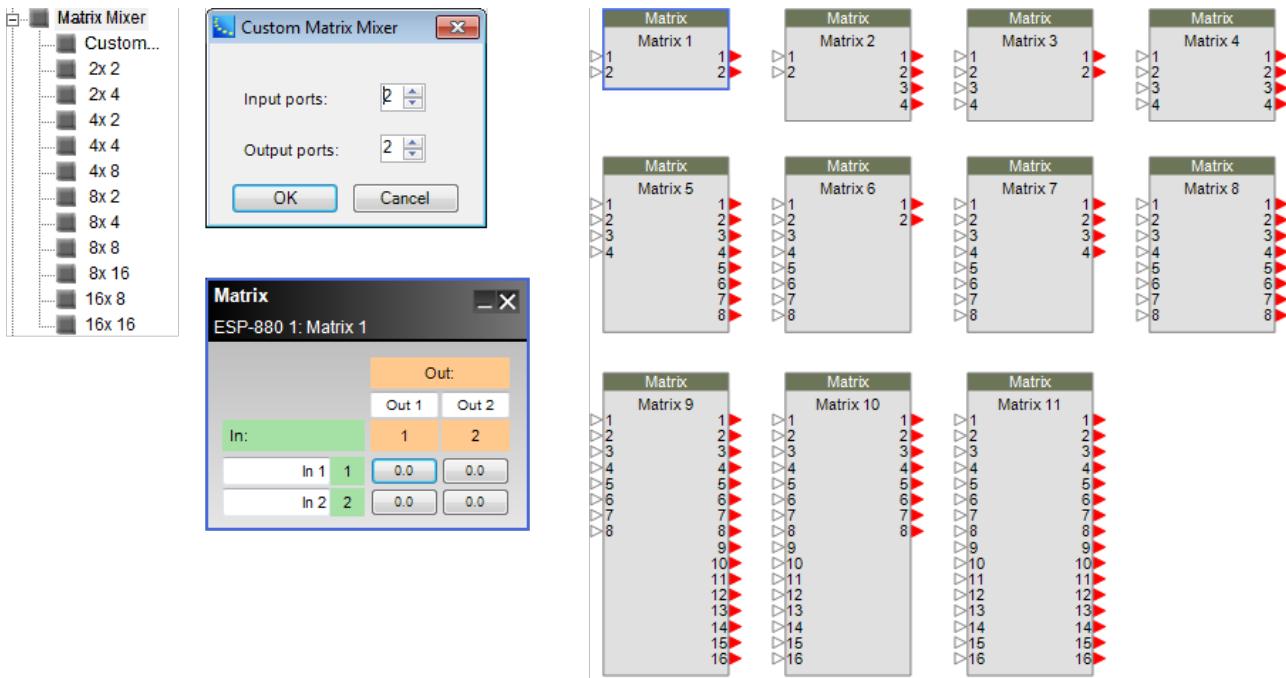
**Bypass** – disables all equalizer settings from affecting the signal.

Gain Sliders – are adjustable for each frequency to boost or cut the level from -15 dB to 15 dB. Type in a boost or cut value in the input box below each slider to set the gain.

Matrix Mixer

The Matrix Mixer is used to route input and output signals, and to adjust the input and output signal levels like the Standard mixer. Matrix mixers are named according to the number of input and output channels they provide. Double-click on a Matrix Mixer block in ESP View to open its control panel. The Custom Matrix Mixer allows you to customize a matrix mixer to meet design requirements.

For details on using the Custom Matrix Mixer option, see "Working with User-Defined Controls" on page 165.

*Matrix Mixer processing blocks and 2x2 control panel*

The **Matrix Mixer control panel** provides the following options:

Assign – creates a routing path between an input and an output. Click the assign button at the intersection of the two channels to permit audio to pass from input to output. When an assignment is made the control panel button is Blue.

Assign Level – provides a signal gain adjustment at the assignment cross point. Right click on an assignment button to access a gain slider. The range of adjustment is from –∞ to 0.0dB

Meters

Meters provide vertical bar level indicators for monitoring signals. Meter processing blocks are available in four, eight, and sixteen channel versions. Double-click on a Meter block in ESP View to open its control panel.
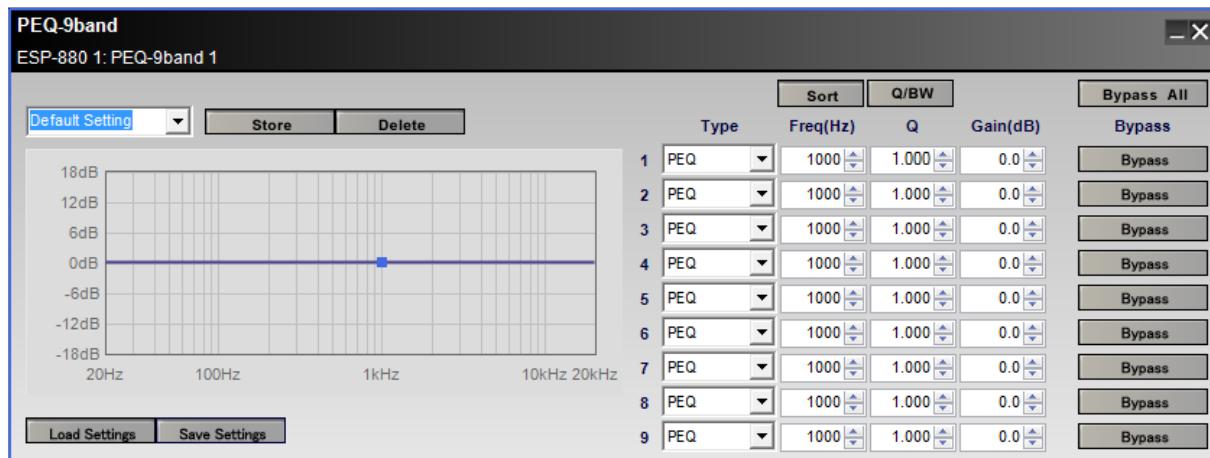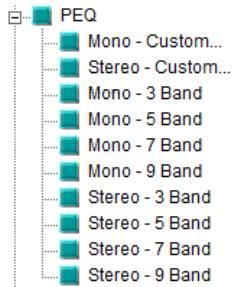
*Meter, processing blocks and 4 channel control panel*

The **Bar Level Indicators** provide a four-color graph to represent signal level. Values range from -60 to 0 dBFS (Full Scale). Color ranges are as follows:

Green	-60 to -20 dBFS
Yellow	-20 to -6 dBFS
Orange	-6 to -2 dBFS
Red	-2 to 0 dBFS

Parametric EQs

Parametric EQs provide multiple filter bands of adjustment to an input signal. Selections include a Mono/Stereo custom block and four mono/stereo 3-band, 5-band, 7-band, and 9-band filters. The control panels for each differ only in the number of bands available for boost or cut. Double-click on the Parametric EQ block in ESP View to open its control panel.

Example: Mono 9-Band Parametric EQ control panel

The **Parametric EQ control panel** provides the following options:

> **Snapshot** – allow you to retain settings of the currently open parametric EQ block for use in other similarly sized PEQ blocks of the system design. Each settings group is called a **Snapshot**.
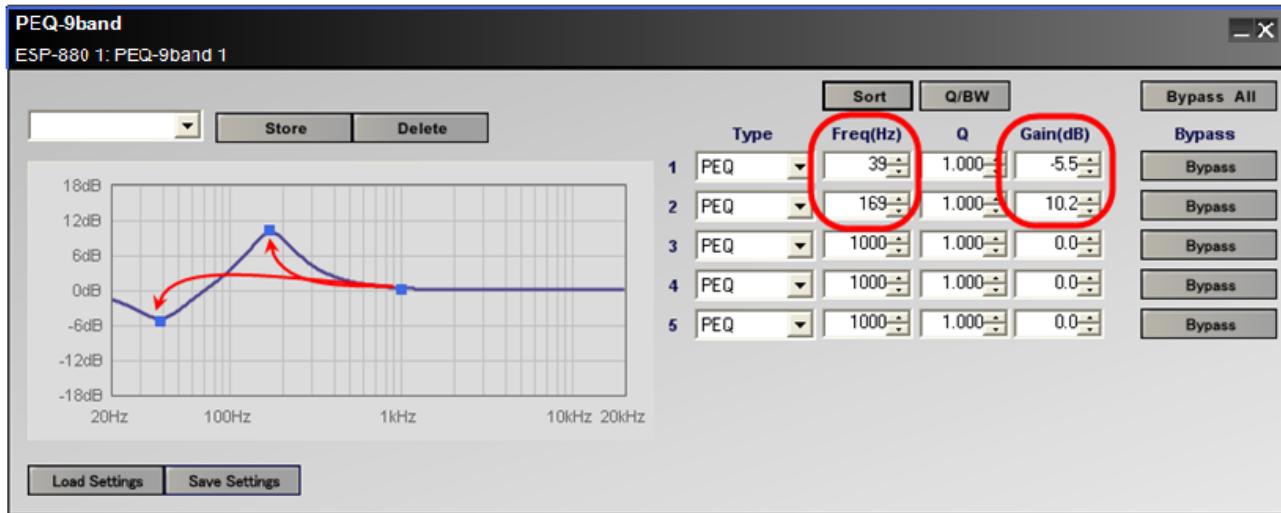
>> **Name -** provides a text box to enter a familiar name for the current settings. When no name is entered, default system names are automatically generated. To save the current name, press the **Store** button.

>> **Store** – commits the current settings to memory. Snapshot names and settings become part of the design file when saved to disk.

>> **Delete** – removes the currently selected snapshot from the drop down list but retains the PEQ settings until a new snapshot is selected.

> **PEQ Graph** – displays a graphical representation of adjustable parametric filter settings in both frequency and level. The dark horizontal line on the graph represents the EQ curve and the blue boxes represent the center frequency of each filter band.

> By default, all center frequencies are positioned at 1000 Hz, so the blue boxes are all at the same point. You may adjust the center frequency and gain for each filter band by dragging the blue box with your mouse in the PEQ Graph.
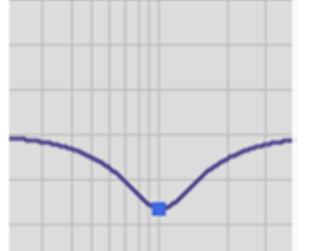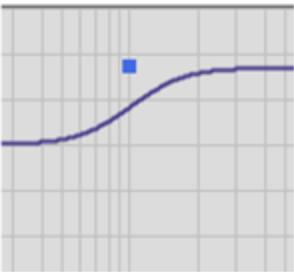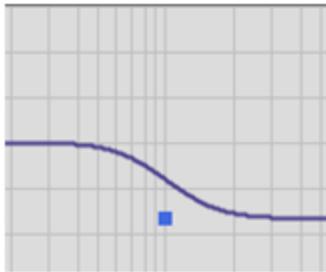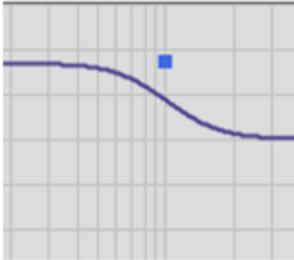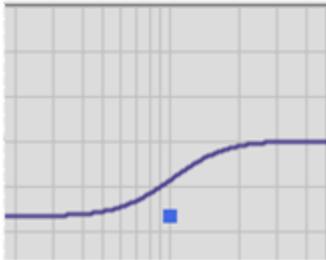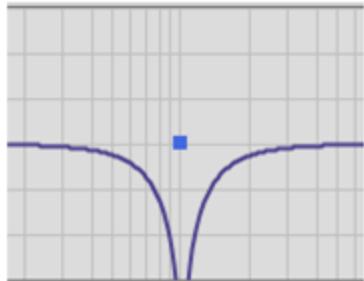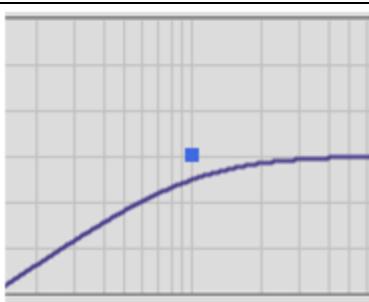
Load / Save Settings – supports the loading and saving of all current PEQ values to an external **.peq** file on the hard drive.

Sort – reorders the list of filters by frequency from low to high.

Q/BW – provides a toggle switch between the two unit systems representing filter bandwidth. Q is the ratio of the center frequency divided by the bandwidth. BW represents bandwidth and is a value in octaves.

Type – is a drop down list of unique filter methods available for use on each EQ band. Filter type descriptions and illustrations are shown below:

PEQ	
Boosts and cuts the signal in the vicinity of the specified frequency.	
High Shelf	
Boosts and cuts the signal above the specified frequency.	

Low Shelf Boosts and cuts the signal below the specified frequency.	
Notch Attenuates the signal at the specified frequency.	
Low Pass Attenuates the signal above the specified frequency.	
High Pass Attenuates the signal below the specified frequency.	

Parametric filter types

Frequency – specifies the center frequency of the filter band in Hertz (Hz). The range of permitted values entered directly into the text box or by using the scroll buttons is 20 Hz to 20 kHz.

Q or BW – is a value representing filter width. This column displays either **Q** or **BW** depending on the state of the **Q/BW** toggle button directly above this column. When using filter types other than PEQ or Notch, this field is de emphasized.

Gain – is the amount of cut or boost to the signal in dB, from -20 to 20. When using Low Pass and High Pass filters, this field is used to adjust the slope of the attenuation curve (-6 dB/Oct, or -12 dB/Oct).

Bypass All – engages all individual bypass buttons simultaneously. When active, the button turns "Green." When inactive, the button is "Gray."
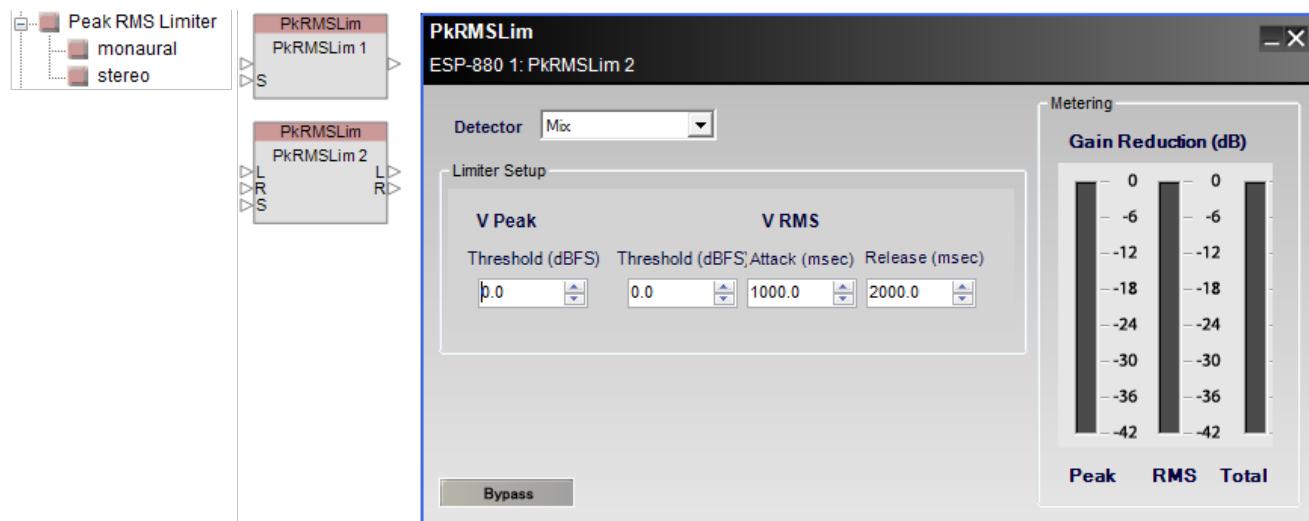
Bypass – Use the Bypass buttons to remove an individual filter from the signal chain. When active, the button turns "Green." When inactive, the button is "Gray."

Peak RMS Limiter

The Peak vs. RMS Limiter processing can be set to protect speakers from thermal damage when excessive power is applied for long periods of time (RMS limiting), and mechanical damage due to over-excursion (Peak Limiting).

Control panels between mono and stereo versions differ only in the choice of input trigger signals.

Double-click on the Peak RMS Limiter block in ESP View to open its control panel.

Peak RMS Limiter block and control panel for stereo limiter

Detector - determines which of the available signal inputs are monitored to trigger the signal processing.

Input - indicates a monaural signal is the trigger for processing.

Left (Stereo only) - indicates the left signal is the trigger for processing.

Right (Stereo only) - indicates the right signal is the trigger for processing.

Mix (Stereo only) - indicates a left/right signal mix is the trigger for processing.

Side Chain - indicates the side chain input is the trigger for processing.

Limiter Setup -

V Peak Threshold (dBFS) - determines when the processing block will begin adjusting the input signal according to its level. A signal level peak above this threshold is prevented from passing through the processing block. The range of adjustment is -40 to 0 dBFS (default).

V RMS Threshold (dBFS) - determines when the processing block will begin adjusting the input signal according to its level. An RMS signal level above this threshold is prevented from passing through the processing block. The range of adjustment is -40 to 0 dBFS (default).

V RMS Attack (msec) - establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

VRMS Release (msec) - determines the rate in milliseconds when signal processing is discontinued after threshold is exceeded.
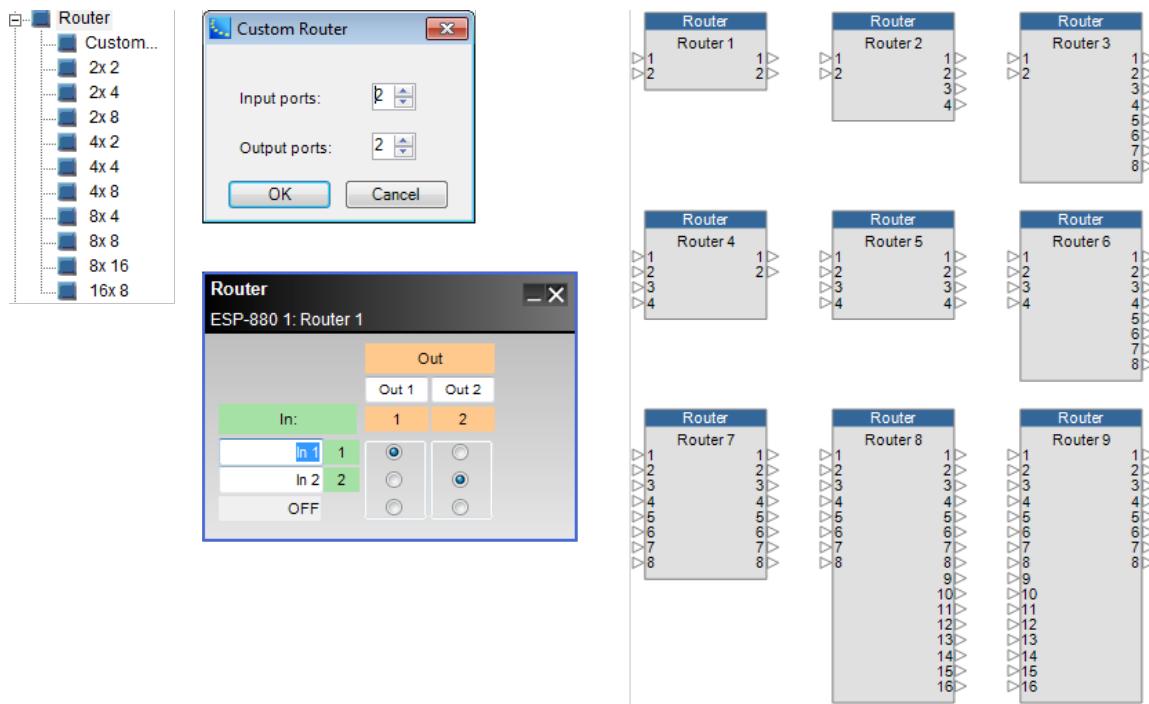
Metering - Gain Reduction (dB) - displays Peak, RMS and Total signal levels.

Bypass - forces the channel to remain open at all times by circumventing the detection circuitry.

Routers

Routers direct individual inputs to one or more outputs within a programmable signal processing block. Routers are named according to the number of input and output channels they provide. Double-click on the router block in ESP View to open its control panel. The Custom Router allows you to customize a router to meet design requirements.

For details on using the Custom Router option, see "Working with User-Defined Controls" on page 165.

Router processing blocks and 2x2 control panel

The **Router control panel** provides the following options:

Input Label – allows direct text entry of user defined labels for inputs.

Output Assignment – is a router cross point connecting one or more inputs to an individual output. Select the cross point to the right of OFF beneath all inputs to disable the output for a specific channel.
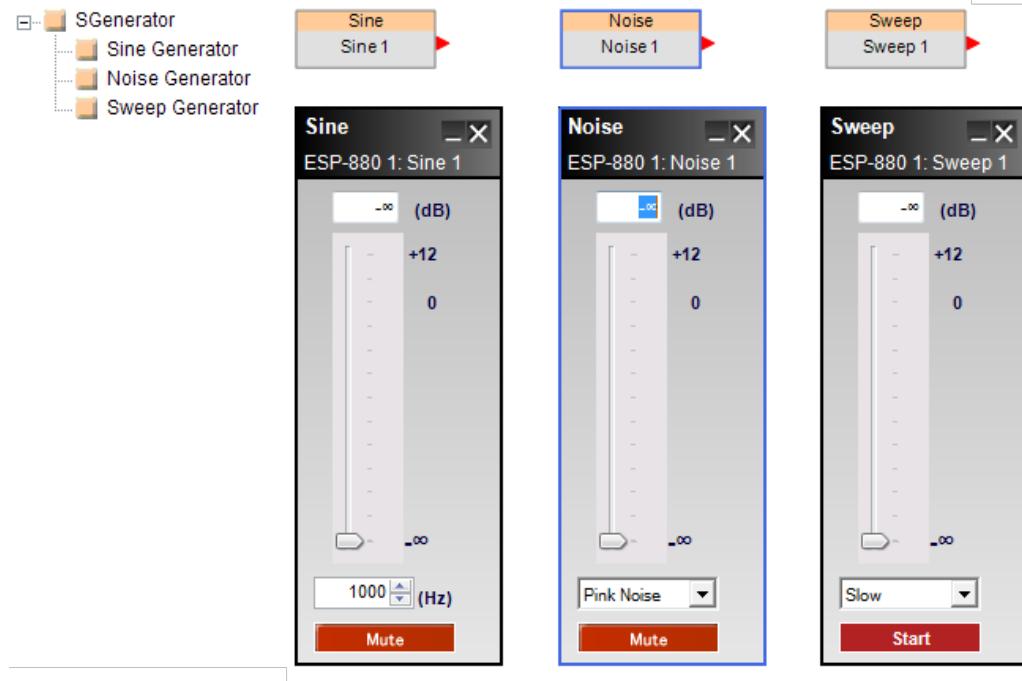
Output Label – allows direct text entry of user defined labels for outputs.

Signal Generator (SGenerator)

The SGenerator is a processing group providing three types of dedicated signal generators:

- Sine
- Noise
- Sweep

Double-click on an SGenerator block in ESP View to open its control panel.

Signal Generators, processing blocks and control panels

The **Signal Generator control panels** provide the following options:

> **Sine Generator** – outputs a sine wave with variable level and frequency.
>
>> **Generator Value** – permits direct text entry of desired output signal level in dB. Range of adjustment matches and tracks the generator gain slider.
>>
>> **Generator Gain Slider** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dB.
>>
>> **Frequency** – permits direct text entry of desired output frequency in hertz. The range of adjustment is from 20 Hz to 20 kHz.
>>
>> **Mute** – silences the signal generator. When Mute is enabled, the control panel button is Red (Default).
>
> **Noise Generator** – outputs two types of broadband noise with variable level.
>
>> **Generator Value** – permits direct text entry of desired output signal level in dB. Range of adjustment matches and tracks the generator gain slider.
>>
>> **Generator Gain Slider** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from –∞ to +12dB.
>>
>> **Noise Type** – provides a selector to choose between the two available types of noise, Pink noise and White noise.

Mute – silences the signal generator. When Mute is enabled, the control panel button is Red (Default).

Sweep Generator – outputs a swept sine wave from 20 Hz to 20 kHz with variable level and speed.

Generator Value – permits direct text entry of desired output signal level in dB. Range of adjustment matches and tracks the generator gain slider.

Generator Gain Slider – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from −∞ to +12dB.
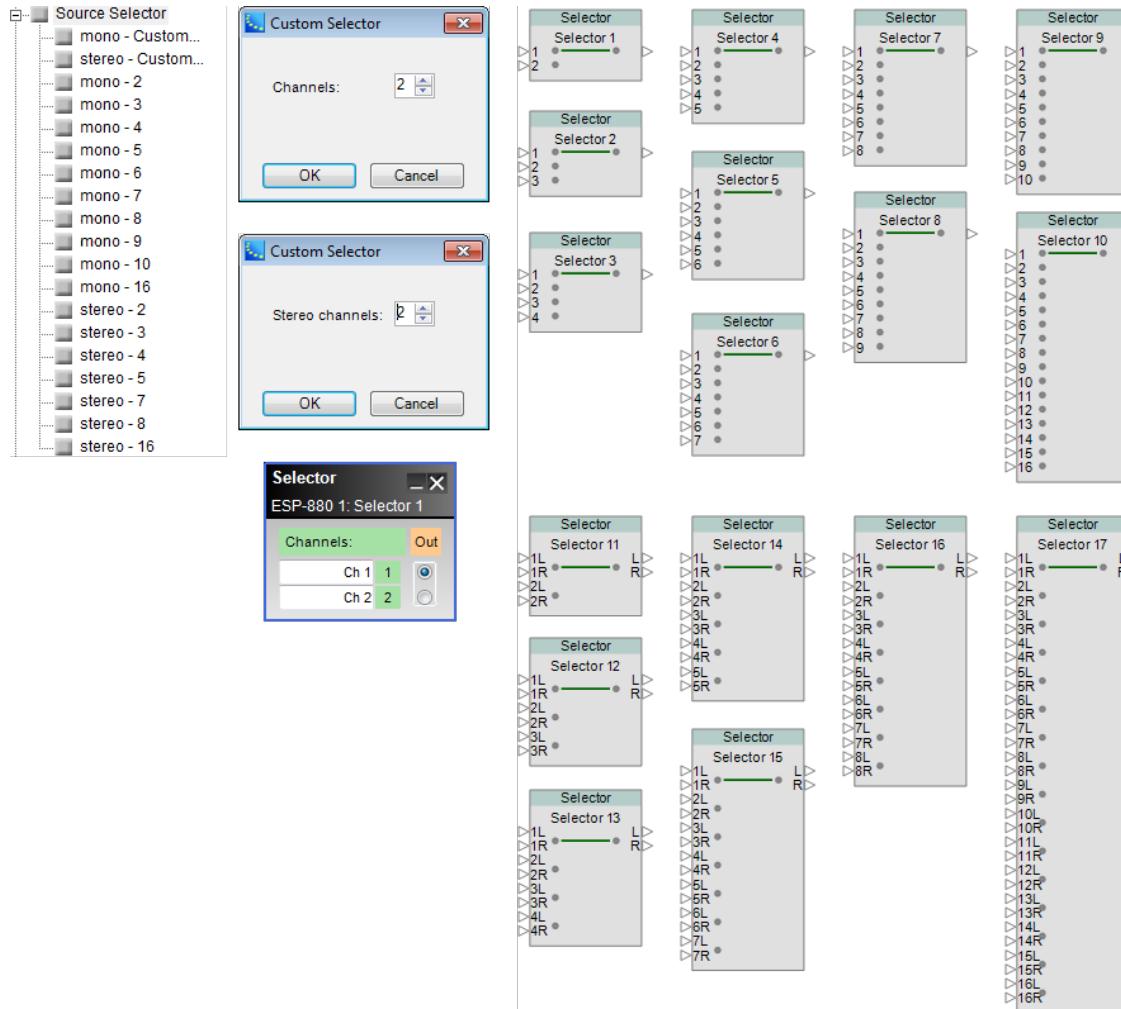
Sweep Speed – provides a selector to choose between the two available rates of sweep, Fast or Slow.

Start / Stop – enables or disables the signal generator.

Source Selector

The Source Selector passes one of its input signals to an output channel. Both monaural and stereo source selectors are available. The Custom Matrix Mixers allows you to customize mono or stereo matrix mixers to meet design requirements. Double-click on the Source Selector block in ESP View to open its control panel.

For more details on using Custom Source Selectors, see "Working with User-Defined Controls" on page 165.

Source Selector processing blocks and mono - 2 control panel

The **Source Selector** control panel provides the following options:

> **Select Channel** – a drop-down menu to select the active input channel.

> **Channel Name** – displays current channel name.

**NOTE: Open the Properties Window to rename source selector channels.**
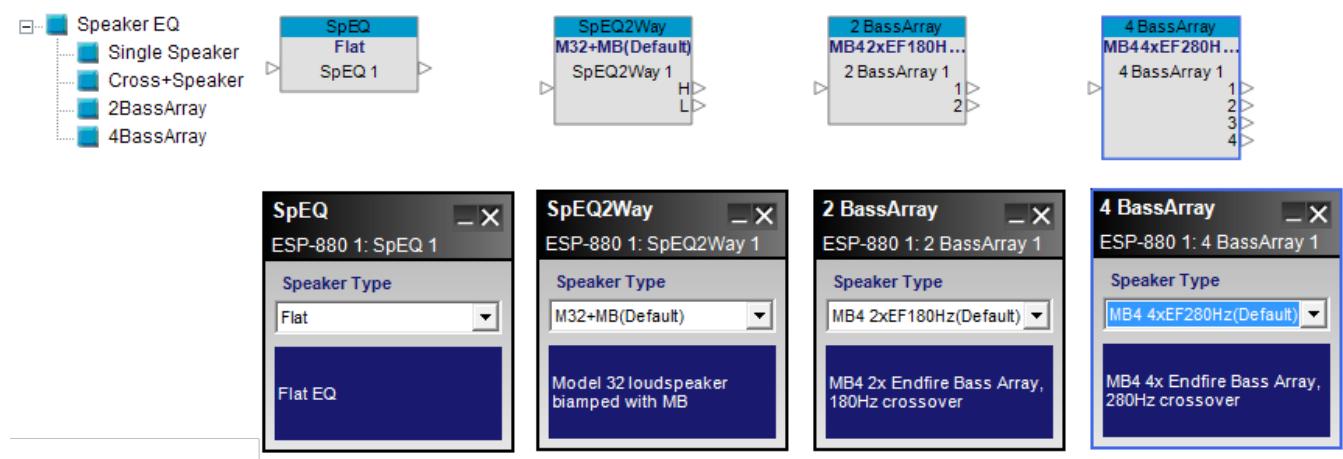
Speaker EQ

Speaker EQ provides pre-configured equalization blocks for Bose loudspeakers and bass arrays.

Four Speaker EQ processing blocks are provided:

- Single speaker output
- Crossover with high and low frequency speaker outputs
- Two-element bass array configurations
- Four-element bass array configurations

Double-click on the Speaker EQ block in ESP View to open its control panel.

Speaker EQ processing blocks and control panels
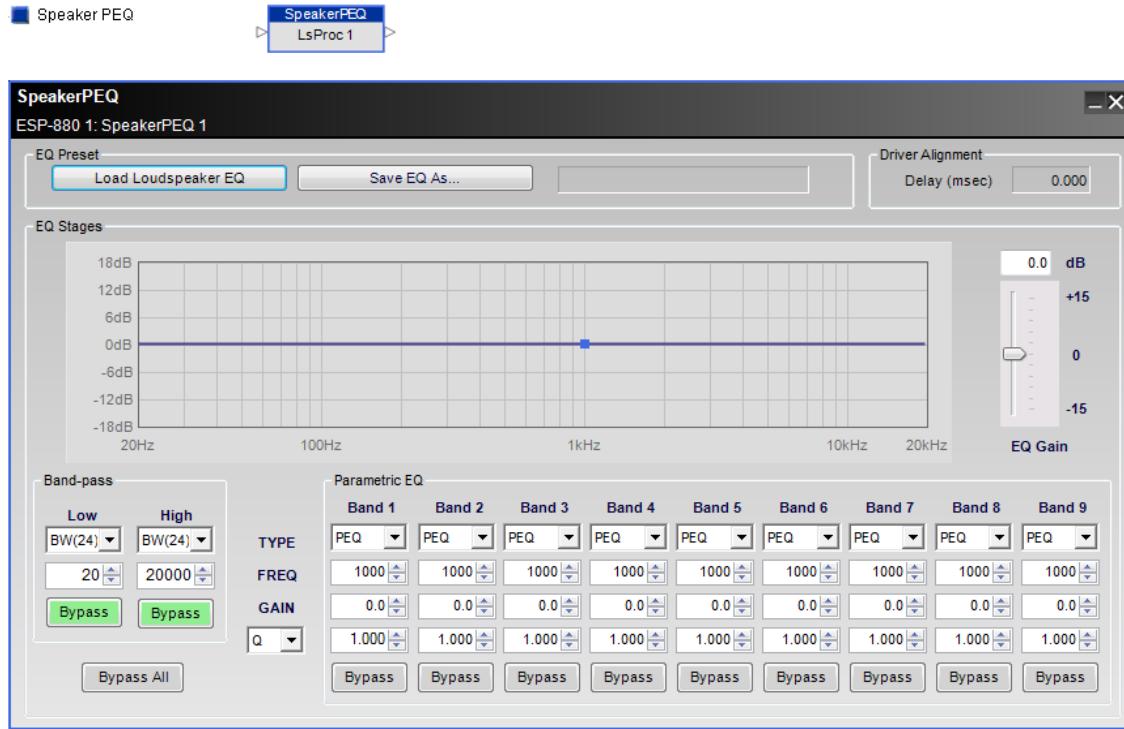
Each **Speaker EQ control panel** provides the following options:

> **Speaker Type** – drop down list with a selection of loudspeakers appropriate for the chosen EQ type.

> **EQ Description** – provides a detailed list of product and configuration options unique to each speaker type.

Bose Speaker Parametric EQ

The Bose Speaker Parametric EQ is an advanced signal processing block to permit loudspeaker equalization, and bandpass within a single design element. Double click its processing block within ESP View to open its control panel.

Bose Speaker Parametric EQ, processing block and control panel

The **Bose Speaker Parametric EQ control panel** provides the following options:

EQ Preset – supports the loading and saving of pre-defined loudspeaker processing values.

Load Loudspeaker EQ – populates this signal processing block from pre-defined settings for Bose loud-speakers. Upon loading, all values are de-emphasized to indicate factory calibration. Adjustments are not permitted to this data.

Save EQ As – presents a dialog to save EQ and loudspeaker settings to an external .SEQ file.

EQ Stages – displays a graphical representation of adjustable EQ filter settings in both frequency and level. The line varies according to values adjustable within the Band-pass and Parametric EQ sections.

Band-pass – determines the low and high pass filter settings for the loudspeaker processor according to filter type and frequency.

Parametric EQ – provides adjustable controls for defining individual parametric filters. Available options are:

Type – determines the filter parameters used for the EQ. Four types of filters are available to define the filter. Options include:

PEQ – establishes a parametric EQ filter approach to remaining settings for this band.

High Shelf - establishes a high frequency (low pass) shelf filter approach to remaining settings for this band.

Low Shelf - establishes a low frequency (high pass) shelf filter approach to remaining settings for this band.

Notch - establishes a filter approach to remaining settings for this band.

FREQ – adjusts the filter center point directly by input in the text box or my using the up and down scroll buttons.

GAIN – determines the individual filter gain from -20dB to =20dB.

BW/Q – sets the field for filter width to either a bandwidth (in octaves) or Q value.

**Bypass –** disables this specific filter from affecting the signal chain.
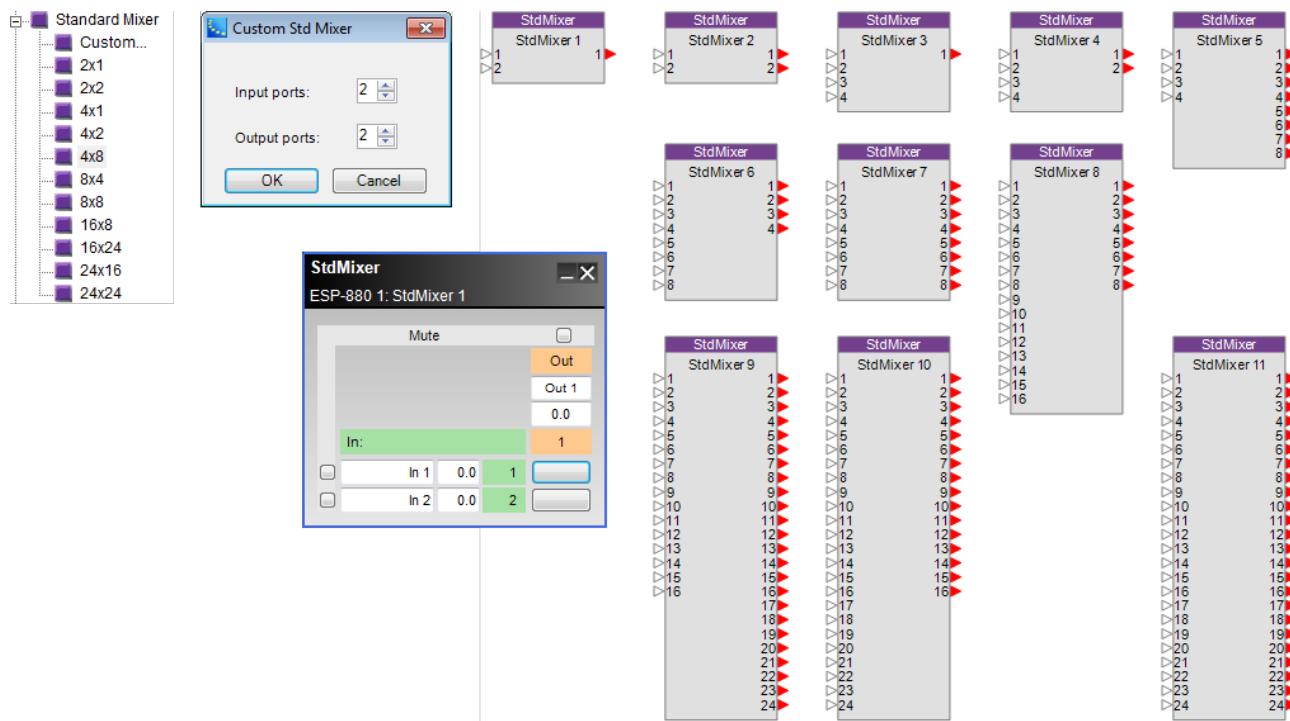
Gain – provides up to +/-15 dB of output gain for the Parametric EQ stage.

Driver Alignment – permits a single delay to add to all loudspeakers connected to this **Bose Speaker Processor** block. This is a read-only parameter for Bose loudspeaker EQs.

Standard Mixer

The Standard Mixer is used to route input and output signals, and to adjust the input and output signal levels. Standard mixers are named according to the number of input and output channels they provide. The Custom Std Mixer option allows you to create a mixer that meets your needs. Double-click on a Standard Mixer block in ESP View to open its control panel.

For more details on the Custom Std Mixer option, see "Working with User-Defined Controls" on page 165.

Standard Mixer processing blocks and 2x1 control panel

The **Standard Mixer control panel** provides the following options:

Input Level – is a direct text entry field for adjusting the input signal. The range of adjustment is from –∞ to +12dB and the input section is shaded in Green.

Output Level – is a direct text entry field for adjusting the output signal. The range of adjustment is from –∞ to +12dB and the output section is shaded in Orange.
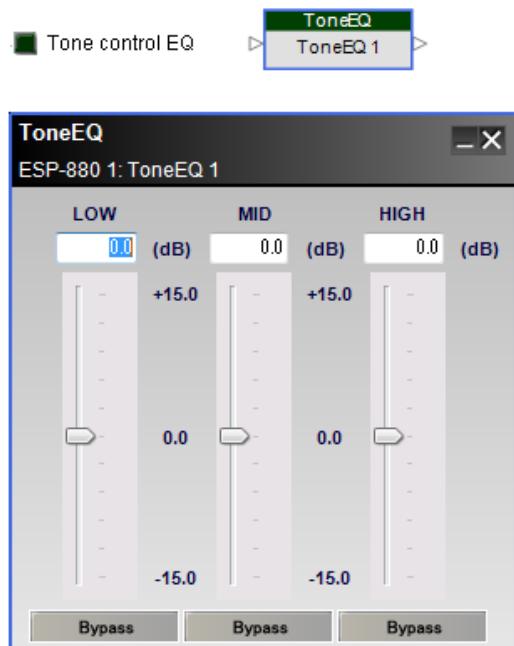
**Note**: To enable –∞ in a direct text field without a gain slider, enter any value less than -60dB.

Assign – creates a routing path between an input and an output. Click the assign button at the intersection of the two channels to permit audio to pass from input to output. When an assignment is made the control panel button is Blue.

Mute – silences the signal on a specific input or output panel and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

Tone Control EQ

The Tone control EQ boosts or cuts the output level at the low, mid, and high frequency bandwidths. Double-click on the Tone control EQ block in ESP View to open its control panel.

Tone control EQ, processing block and control panel.

The **Tone control EQ control panel** provides the following options:

LOW – controls a 200Hz 6dB per octave filter adjustment to the original signal.

Gain slider –is adjustable to boost or cut the level from -15 dB to +15 dB. Type in a boost or cut value in the input box above this slider to set the gain.

Bypass – disables this specific filter from affecting the signal chain.

MID – controls a 1000Hz (Q = 1.414) 6dB per octave filter adjustment to the original signal.

Gain slider –is adjustable to boost or cut the level from -15 dB to +15 dB. Type in a boost or cut value in the input box above this slider to set the gain.

Bypass – disables this specific filter from affecting the signal chain.

HIGH – controls a 5000Hz 6dB per octave filter adjustment to the original signal.
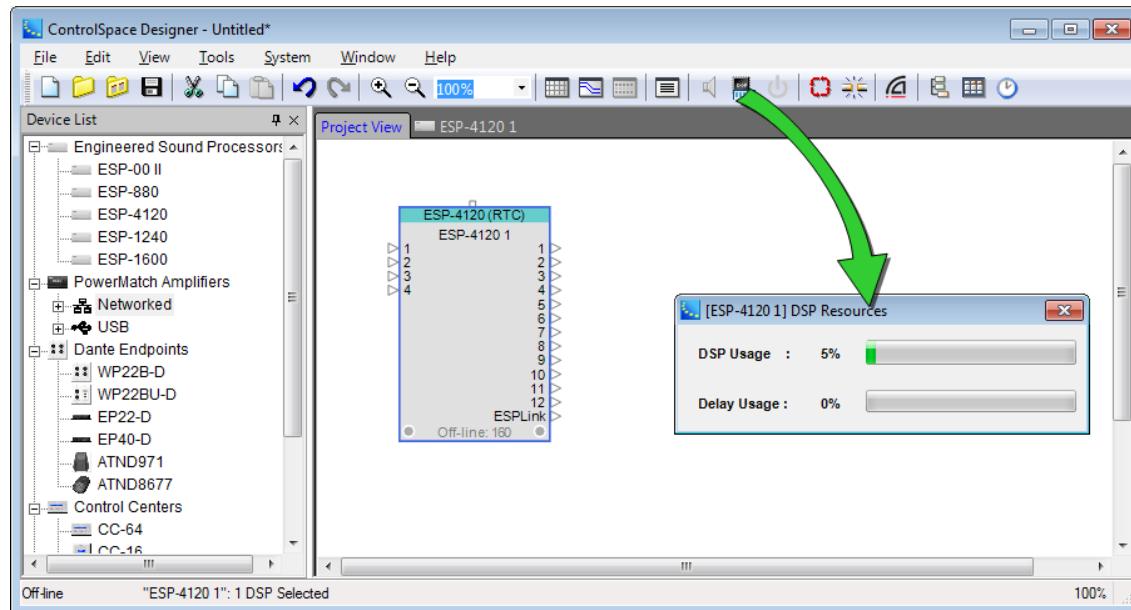
> **Gain slider** –is adjustable to boost or cut the level from -15 dB to +15 dB. Type in a boost or cut value in the input box above this slider to set the gain.

> **Bypass –** disables this specific filter from affecting the signal chain.

Estimating DSP Usage

Estimating DSP usage in a system design is accomplished by accessing the DSP Resources Window.

Select the ESP icon in the Project View and click the DSP Resources tool in the Main Toolbar.

DSP Resources Window

The **DSP Resources Window** displays the following information:

DSP Usage – Indicates the current numeric percentage of capacity used for signal processing along with a horizontal bar graph.

DSPType – Indicates standard DSP card (DSPx1) or optional DSP expansion card (DSPx4) (ESP-88 only).

Delay Usage – Indicates the current numeric percentage of capacity used for signal delay along with a horizontal bar graph.
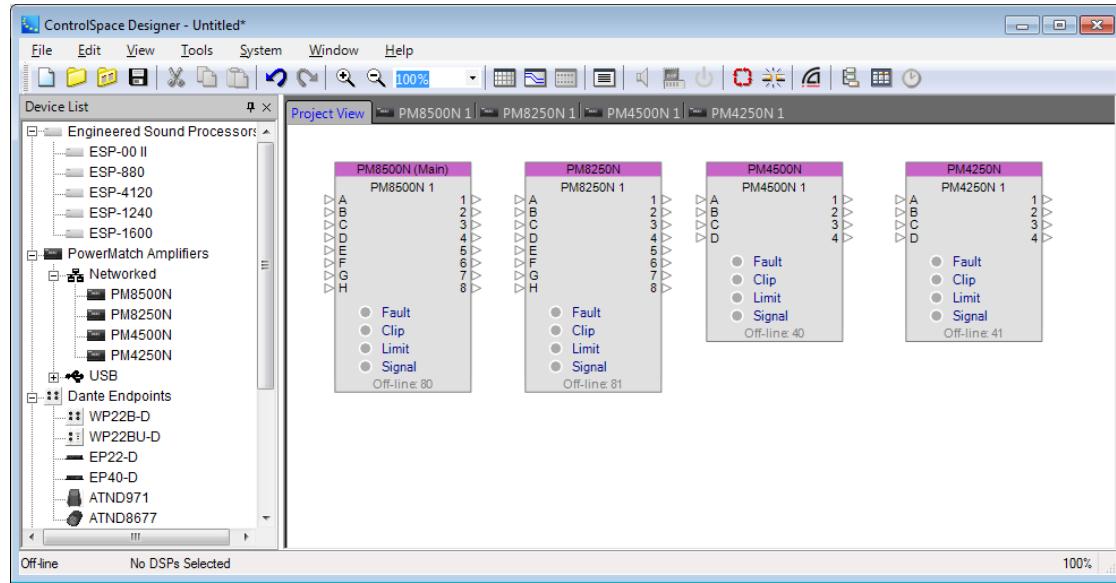
PowerMatch® 8500/8250/4500/4250

PowerMatch® Configurable Professional Power Amplifier Devices

There are eight PowerMatch devices in the Device List shown below; Four available via a network/USB connection and four available via a USB connection only.
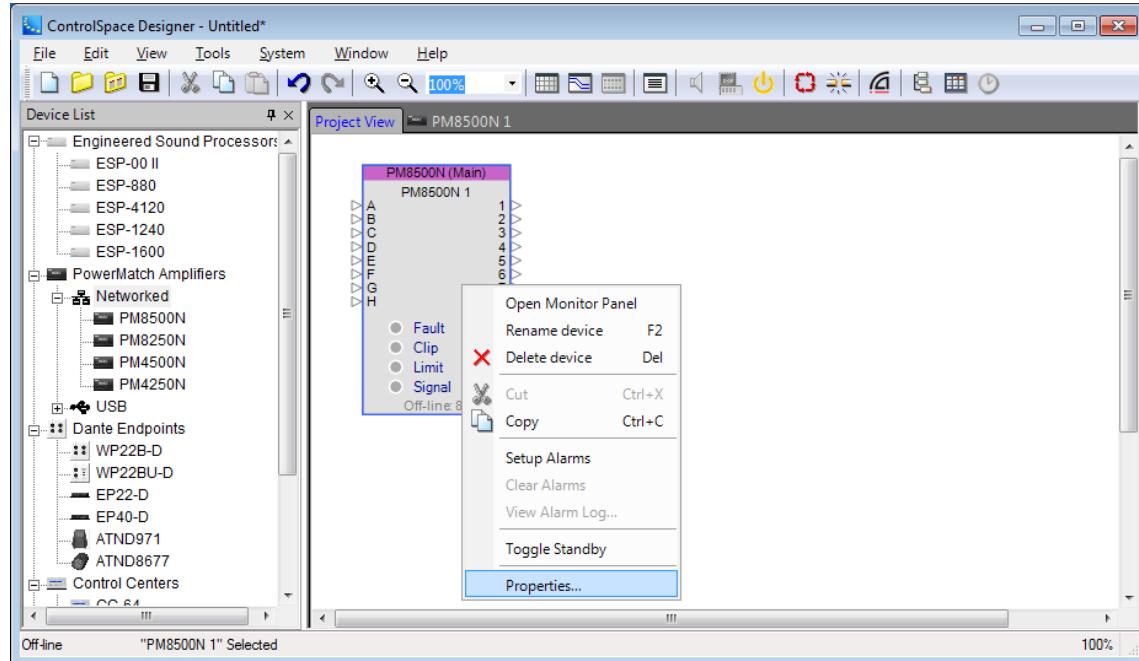
While signal processing between networked and USB-only versions of PowerMatch amplifier models are identical, USB versions do not include an Ethernet network connection and may only be configured using its USB connection.

The devices are added to the Project View using the same drag and drop mechanism as other devices within the ControlSpace® Designer™ software.
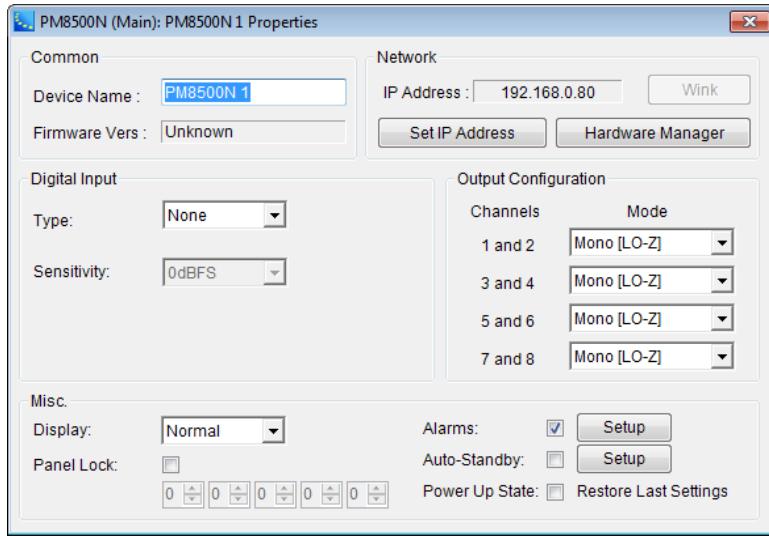
Amplifier Properties

To view the device properties for a PowerMatch® amplifier, right click the amplifier's Project View icon and choose Properties from the context menu.

From within the PowerMatch amplifier device properties you can specify the amplifier output configuration, the digital input card type and network communication options. When selected, the Properties panel is displayed as shown:

From within the Device Properties, the following options are available:

Common – Contains the properties that are common to all devices within ControlSpace® Designer™.

Device Name – This is the label used for the amplifier within ControlSpace Designer. Once a connection is established, this name is displayed on the front panel of the unit.

Firmware Vers – Displays the currently loaded firmware version of the device. "Unknown" is displayed when the device is initially dragged into the Project View. This field updates after going online.

Network – Displays the current network settings for network versions of PowerMatch amplifiers. Within the properties pane for the USB versions, this section is labeled "Device Identification" since no network options are available.

Set IP Address – Clicking this button allows you to change the IP address of the device.

Hardware Manager – Clicking this button opens the Hardware Manager dialog.

Wink – Causes the front panel display of the unit to flash momentarily. This function is available only when the amplifier is on-line.

NOTE: All network versions of PowerMatch amplifiers are configured for DHCP operation at the time of manufacture. When an installation is performed, the network configuration should be set to fixed IP addressing. See Managing device addresses to learn how to modify the network settings for a PowerMatch amplifier.

Digital Input – Selects the type of digital card installed in the Expansion slot: None, ESPLink, CobraNet, Dante, or AES3. When a digital input is selected, the corresponding digital inputs/outputs are displayed on the device view of the PowerMatch amplifier.

NOTE: Device properties for PM4250/N and PM4500/N amplifiers allow selection between the upper 4 or lower 4 channels of the digital input card. This allows you to send 8 channels of audio to the amplifier, with channels 1-4 carrying separate program material from channels 5-8.

Output Configuration – Determines the output mode for each pair of amplifier outputs. See the Output Configuration section for additional details.

Misc

Display – Determines the display brightness for the front panel display of the hardware. Available settings are High and Low.

Alarms – Activates alarm messaging. When selected, the PowerMatch amplifier broadcasts alarm conditions on the network. Select Setup to configure the alarm conditions that will trigger a notification. See Working_ With_Alarms for instructions.

Auto Standby – Activates automatic standby. When selected, the PowerMatch amplifier will automatically place itself into standby when it no longer detects an input signal after a specified time period. Click Setup to configure Auto Standby.

Panel Lock – Enables the front panel lock. Use the numeric lock to specify the access code. Once the front panel is locked, you will be required to enter the passcode when connecting to the PowerMatch amplfiier using either the network or USB interface.

Power Up State – The power on state describes the state of the hardware settings at the time the amplifier has power applied, or comes out of Standby. In USB models the default selection is "restore last settings", and in Network models the default is to have this selection disabled.

When **Restore Last Settings** is selected the amplifier will save its current operating state when powering down, or entering standby. When power is restored these settings will be restored. This is the default operation for USB-only models.

When **Restore Last Settings** is deselected the initial 'power on state' that was saved at the time the configuration was sent to the hardware using ControlSpace Designer software. This is the default operation for network models.
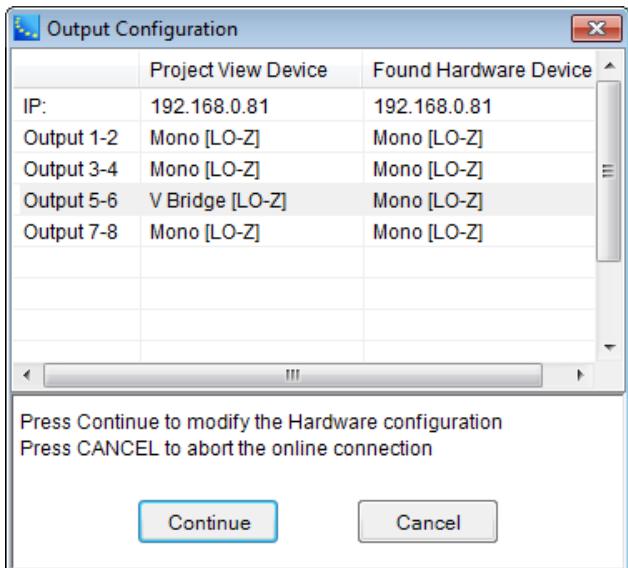
Output Configuration

Each pair of PowerMatch® amplifier outputs may be configured for Mono, V-Bridge, or I-Share mode to accomodate various loudspeaker loads and power levels. In addition, four amplifier channels, two pairs, may be configured for operation in Quad Mode (Current and Voltage Bridged) to deliver 4 times the power of a single channel.

To configure the output section of a PowerMatch amplifier:

1. **Go Offline**. The output configuration may only be changed when the PowerMatch amplifier is off-line.

2. Display the Amplifier Properties. Output configuration settings are located within the amplifier properties panel.

3. Select the desired **Output Configuration**.

4. Close the **Properties** panel.

5. **Go Online**. Select the Go on-line button or choose Go on-line from the Tools Menu.

6. Select **Send to Devices** from the available options.

   You will receive the output configuration confirmation dialog if the output configuration in the Project View does not match the output configuration of the hardware.

The differences in the output configuration between the Project View and the hardware are highlighted.

7. To accept the change in output configuration, click **Continue**.
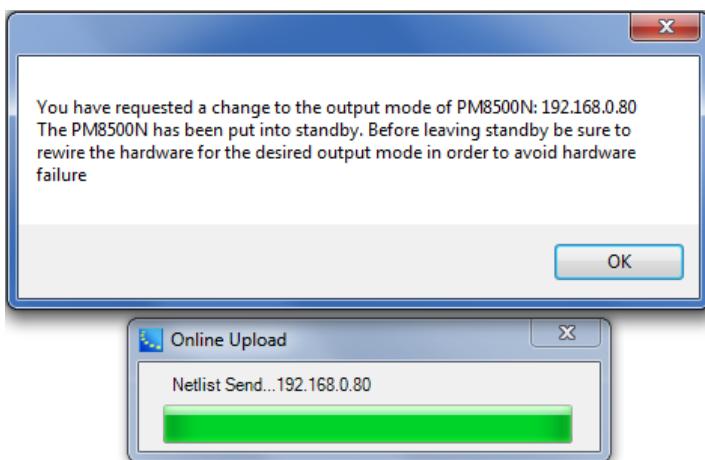
   To ignore the change and leave the hardware untouched,click **Cancel**.

   When **Continue** is selected, the new configuration settings are sent to the hardware.

   Configurations which do not require a special jumper, Mono and VBridge, are implemented immediately within the hardware once the connection is established.
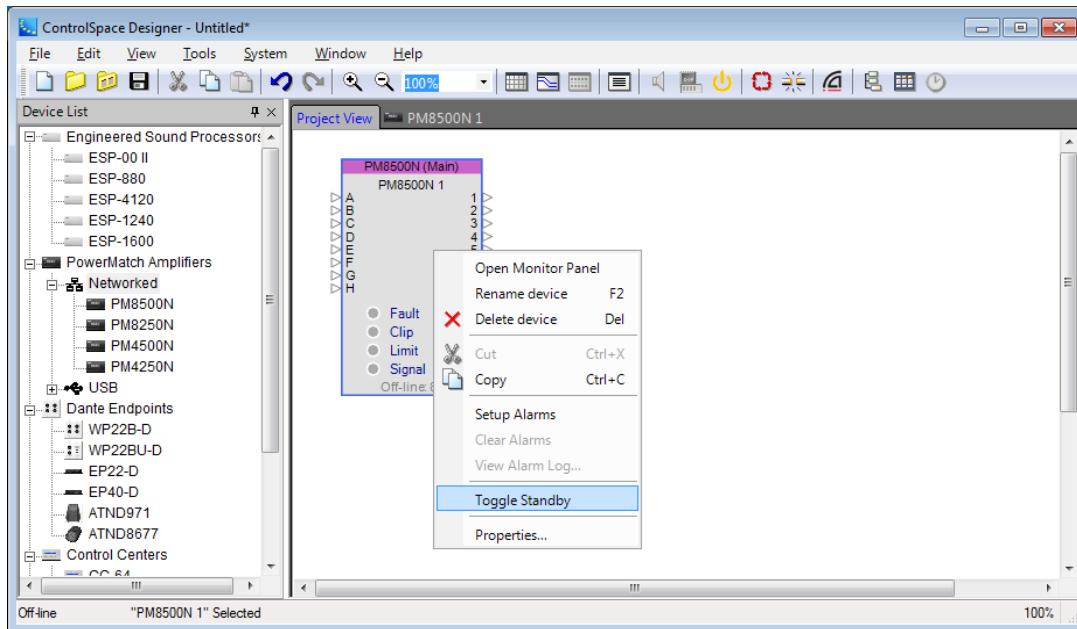
   Configurations which require the installation of a output wiring jumper, I-Share and Quad Mode, require the unit to be placed into standby.

   At this point you are presented with a secondary dialog asking you to confirm that the output wiring is correct for the selected output configuration:
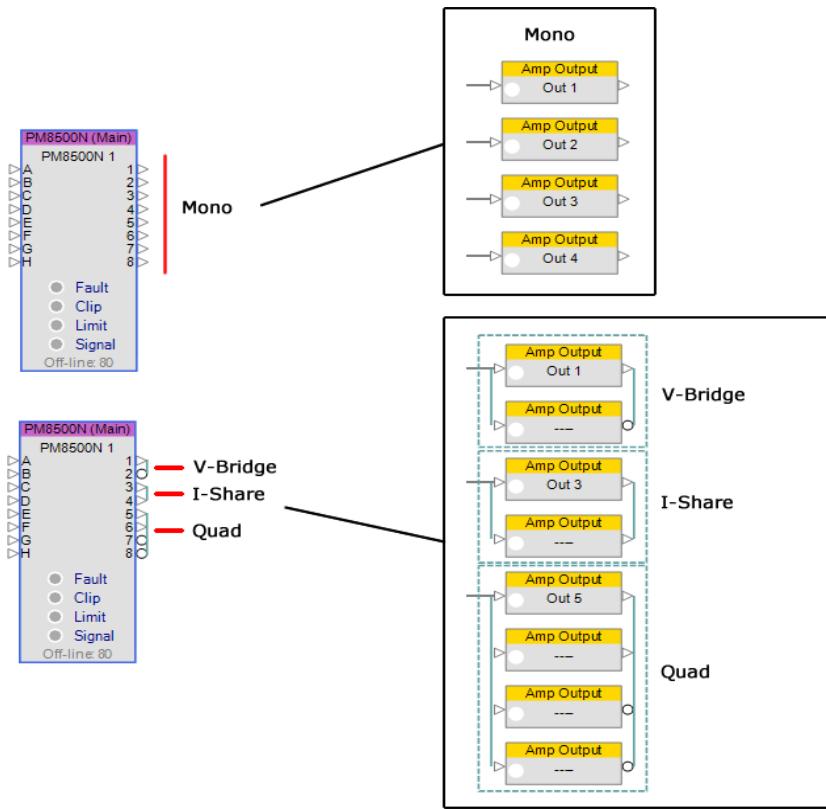
8. Select **OK** to send the new settings to the hardware, and establish a connection to the amplifier. At this point you will be on-line and connected to the amplifier, although it will be in standby.

9. From within Project View, right-click on the amplifier's icon and select **Toggle Standby** to place the unit into operation.

10. The Project View and Signal Processing View for the PowerMatch amplifier reflect its current output configuration. You can use these displays to determine the currently active output configuration for the amplifier.

USB connection
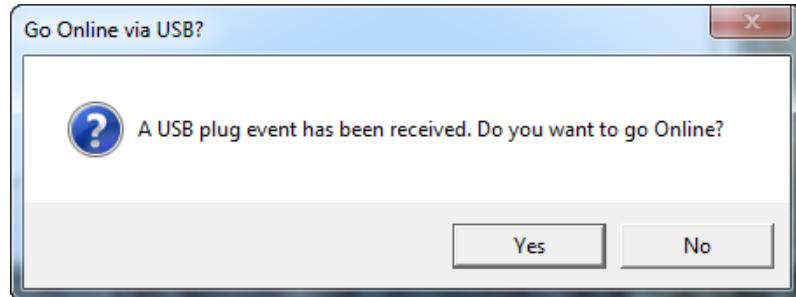
The USB control of a device from within ControlSpace® Designer™ software offers an enhanced level of device control as compared to what is available from the front panel. Some devices, like the PowerMatch amplifiers, are available but do not support Parameter Set and Group control of individual processing blocks.

The USB connection may be used to configure processing parameters within the amplifier, monitor operation in real time, or to quickly service and replace an existing system.

NOTE: ControlSpace Designer software does not support simultaneous USB connections. Only a single device may be controlled via a point to point USB at one time; multiple devices connected to the PC via a USB hub is not supported.

Initial USB Connection

When launching ControlSpace Designer software (or plugging in a PowerMatch amplifier while ControlSpace Designer is running) you will be prompted to establish a connection with the hardware.
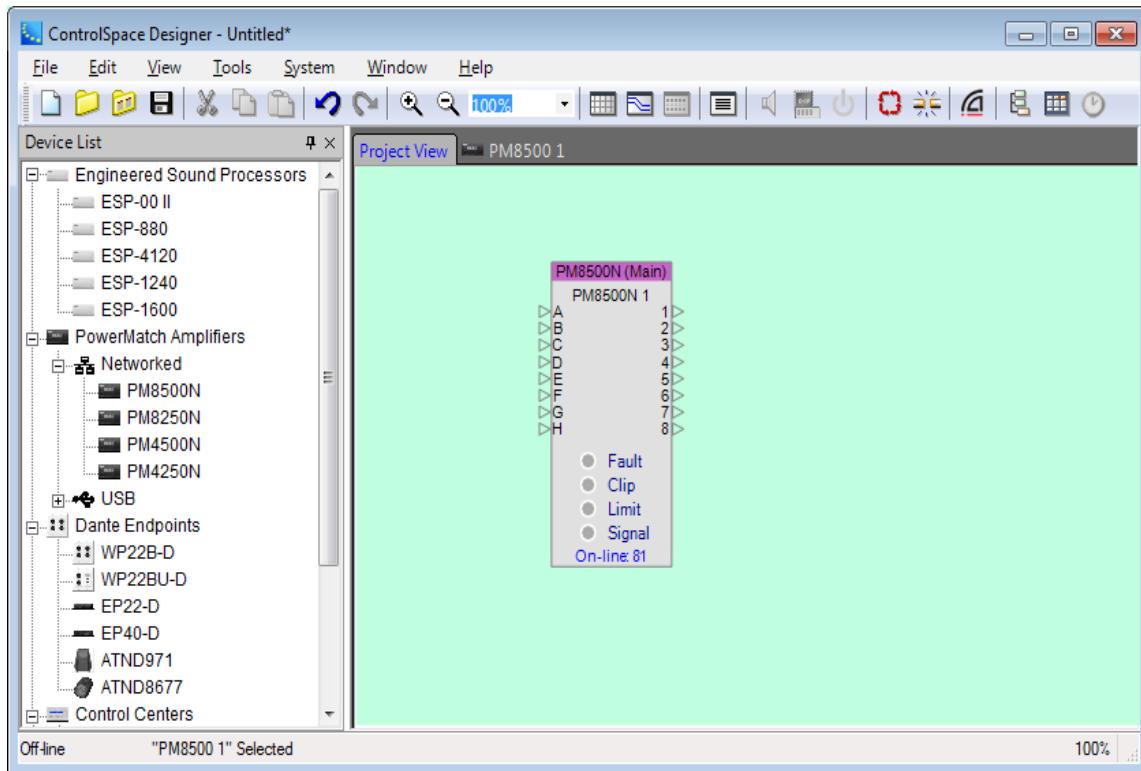
USB Connection Dialog

As the connection is established you will need to determine how you wish to connect to the hardware. Available options are to retrieve the hardware settings and display them within ControlSpace Designer, replace the current hardware settings with those in ControlSpace Designer software, or to do nothing.

Settings Transfer Dialog

Once the USB connection has been established between the PC and hardware the PowerMatch amplifier is displayed within the Project View. An active USB device connection is indicated by green background in both the Project and Signal Processing Views.

USB Device Numbering

Each USB device within a ControlSpace project uses a unique Device ID. The first USB device uses an ID of 1, and as devices are added to the project view the device IDs are automatically incremented.
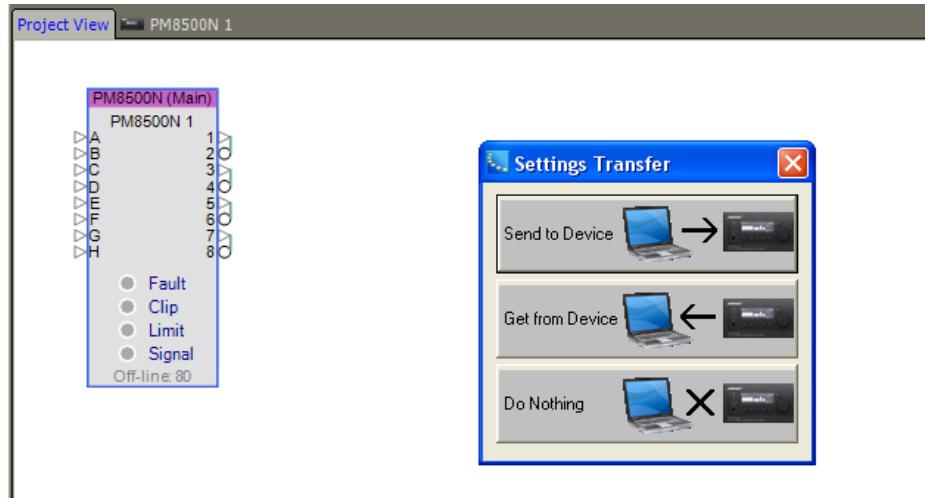
Each USB device ships with a Device ID of 1 from the factory. When multiple USB devices are used within a single project you will need to manage the device addresses carefully to avoid applying the incorrect settings to the hardware.

Once a device connection is established between a device and ControlSpace Designer software the association is stored with the Project File. This relationship is maintained for subsequent connections.

Adding a Device to the Project via USB

When connecting to a device via USB ControlSpace Designer software determines if the new device exists within the project. If the device does not exist within the Project it will be automatically added to the Project View and a connection will be established.

If, however, a USB device of this type are already present within the Project View, and the Device IDs match you will be asked to determine how you would like to manage the hardware configuration and settings.
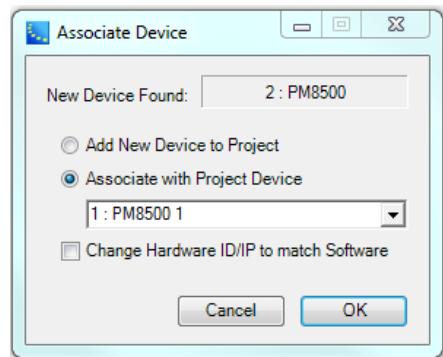
Settings Transfer:

> **Send To Device** – Applies the current configuration and processing settings of the Project View device to the hardware.

> **Get From Device** – Applies the current configuration and processor settings of the hardware to the Project View device.

> **Do Nothing** – Stops the connection process and restores control to the ControlSpace Designer software.

In some situations the Device ID of the hardware does not match any of the Device IDs within the Project. In this case you must determine if the hardware to which you are connected is represented by one of the current devices in the Project View, or if it is a new device which must be added to the project.

Associate Device:
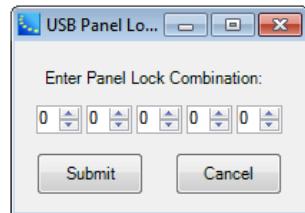
> **Add New Device to Project** - Adds the device to the Project View. Click **OK** to establish a connection.

> **Associate with Project Device** - Activates the Device List drop-down menu. From this list, select the Project View device to associate with the hardware. Click **OK** to establish a connection. Any hardware reconciliation dialogs will appear as necessary.

> **Change Hardware ID/IP to match Software** - Changes the ID/IP of the new device to match ID/IP used in ControlSpace Designer software.

Front Panel Lock Enabled

A PowerMatch amplifier may be configured to have the front panel locked to prevent access to the system. When a USB connection is established with an amplifier in a locked state you will be prompted to enter the front panel lock combination to enable the connection.

Closing a USB Connection

USB connections may be closed by either selecting the Go Offline menu item from the System Menu, or by disconnecting the USB cable between the PC and hardware.
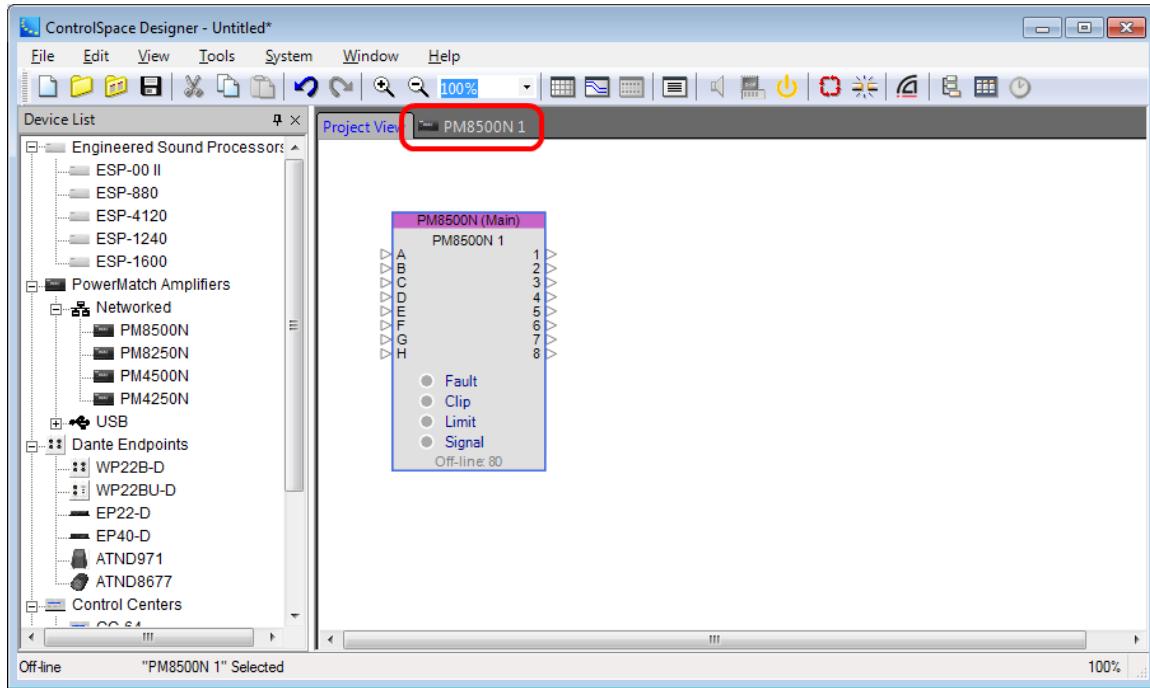
When supports the control of devices which are configured for USB control. The first time a USB enabled hardware device is connected to the PC you will be prompted to locate and load the correct USB driver for the device. Once this step is performed all subsequent connections via USB will occur automatically.

Signal Processing
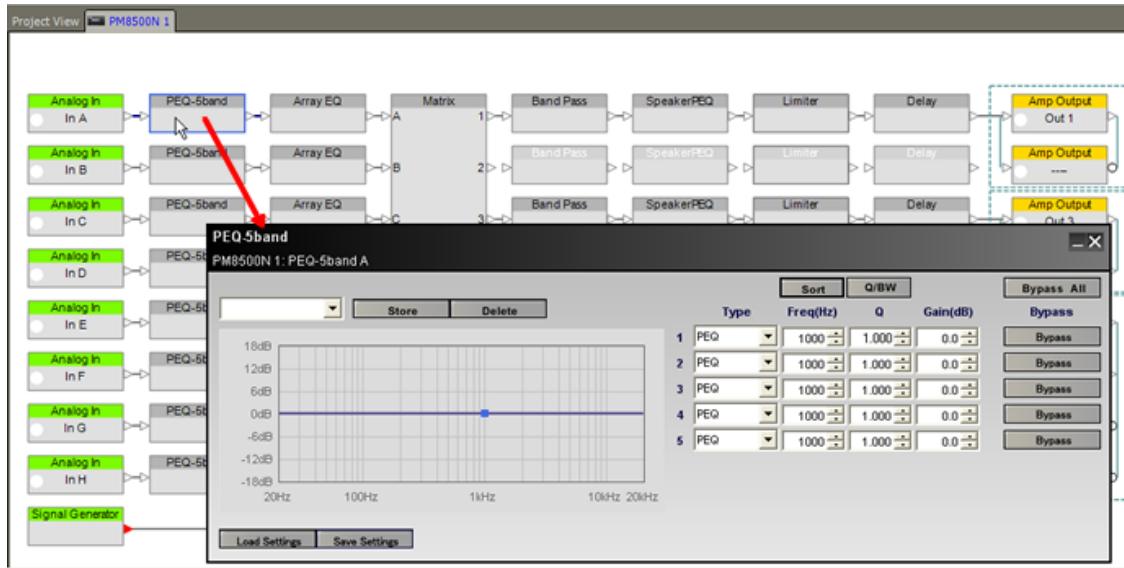
Signal Processing View

PowerMatch® amplifiers include an integrated loudspeaker processor to provide loudspeaker and array processing for Bose loudspeakers. A fixed block diagram architecture provides input signal processing, routing and output signal processing. The signal processing may be pre-configured and sent to the hardware upon connection, or configured while connected and the settings saved within the hardware.

To view the signal processing functions within the PowerMatch amplifier, select the amplifier's signal processing tab.
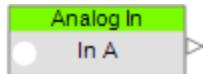
The signal processing view includes the full block diagram. To access any of the signal processing functions, double click on their device icon to expose their control panel.

Input Control

Control of the input sensitivity for each of the eight inputs, and selection between the input source type, analog or digital, is accomplished using the input Control Panel. Within the signal processing view each input is represented as a block.

Input Type – Displays the input type as either Analog, for analog inputs, or Digital for digital inputs as defined by the current hardware configuration.

Input Label – Default label is "Input n", and may be modified while off-line.

Output Connection – Displays the output connection status (active or mute), and is not user accessible (i.e. the user cannot "wire" this output to another input).

Input Signal Level Meter – Displays the current input signal level as green, yellow, orange or red.

To access the Input Control Panel, double click on any of the eight input blocks.

The available controls and indicators for the Input Control Panel are described below:
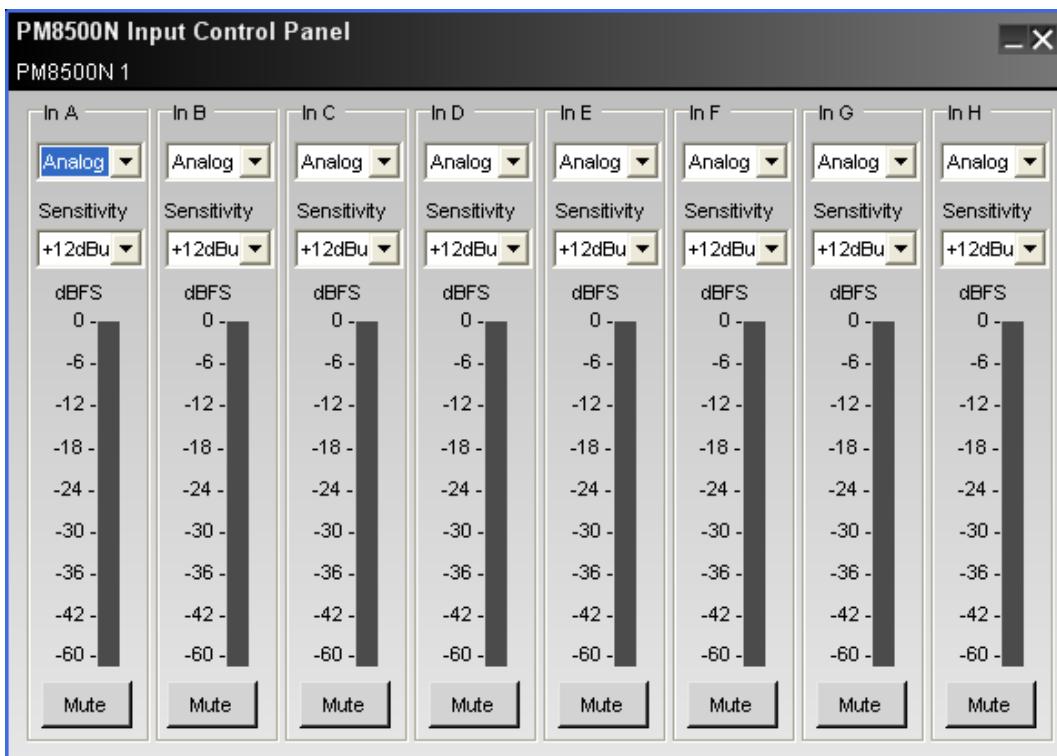
Image representative of 8 channel amplifiers. Four channel models have 4 input controls, (A-D).

Input Channel Label – Reflects the label applied in the Signal Processing view. The default channel label is "In n."

Input Source Select – Selects the desired input source – analog or digital for each input. Digital is available for any of the Digital Type selections (ESPLink, CobraNet, Dante, AES-3) in the properties panel of the device.

Input Channel Sensitivity – Selects the desired input signal level to drive the PowerMatch amplifier to its full output. This item is only available for analog inputs. Digital input sensitivity is found in the amplifier properties panel.

The analog input sensitivity you select will determine the available input headroom and dynamic range of the input channel. When selecting the input sensitivity it is important to determine that appropriate level of noise

performance for the application. See the PowerMatch amplifier *Installation Guide* for detailed information related to the Analog and Digital input sensitivity settings.
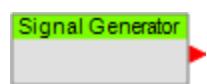
Input Channel Signal Level Meter – Displays the current input signal level and is scaled to 0 dBFS and OFF (-inf or MUTE).

The meter is monitoring the signal level post A/D conversion, and is monitoring the RMS signal level.
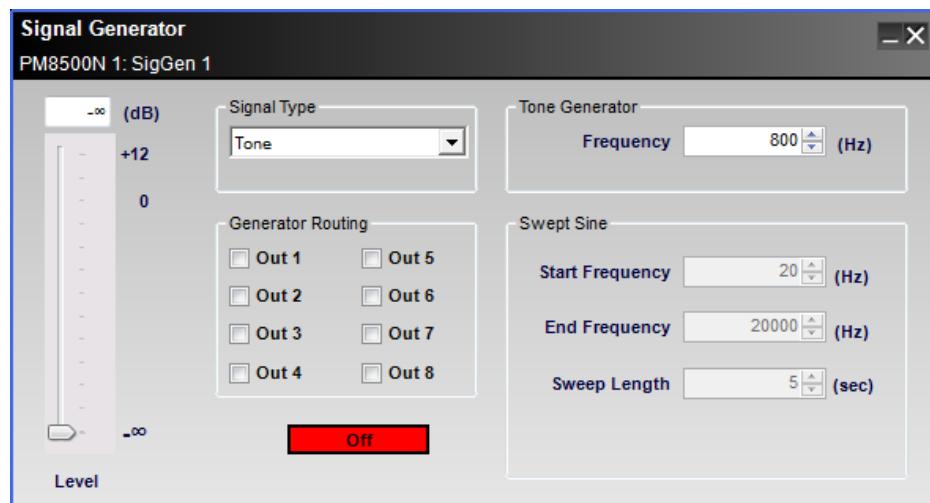
Input Channel Mute – Applies a full mute (no audio) to the selected input channel. When the input is in a mute state the input meter is still active as a reference.

Signal Generator

A signal generator is available within the signal processing diagram for a PowerMatch amplifier to provide the functions of a tone, sweep and noise generator. Within the signal processing view, each Signal Generator is represented as a block. By default, the signal generator is muted to prevent accidental damage to any loudspeakers connected to the amplifier outputs. The output connector displays the output connection status (active or muted).

The available controls and indicators contained within the Signal Generator Control Panel are:

Level – Adjusts the output level from the signal generator

Signal Type – Selects the type of signal type to be generated: Pink Noise, White Noise, Tone, or Sweep.

Generator Routing – Selection for the output where the signal generator will be routed.

**Generator On/Off** – Activates or deactivates the noise generator
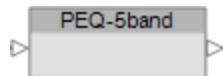
Tone Generator Frequency – Selects the desired frequency for the tone generator in Hertz.

Swept Sine (Start Freq/End Freq/Sweep Length) – Defines the start and stop frequencies, in Hertz, and the sweep length, in Seconds.
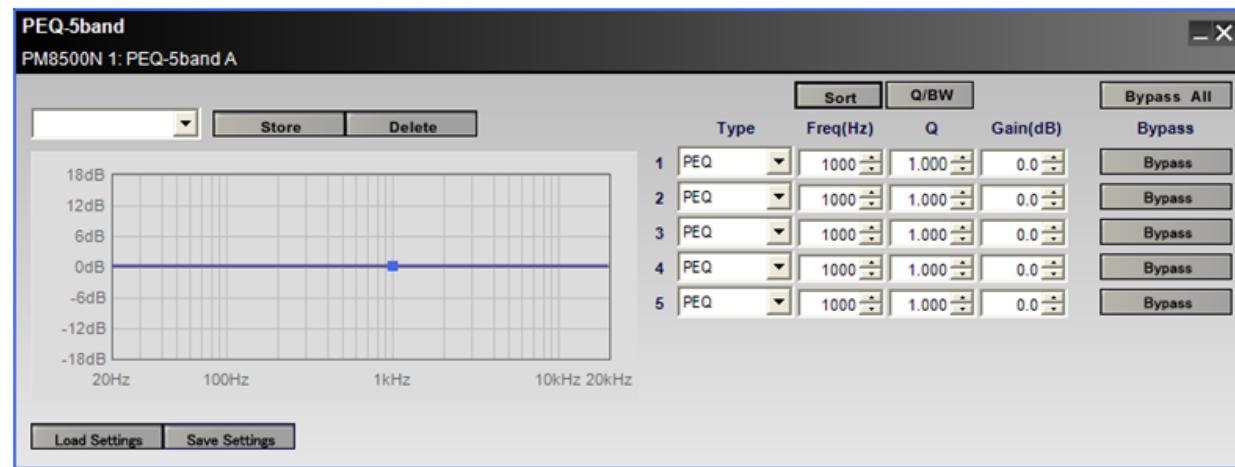
NOTE: It is possible to create a reverse sweep by setting the Start Frequency higher than the End Frequency.

Input Parametric EQ

Each input signal processing chain includes an Input Parametric EQ. Within the signal processing view each Parametric EQ is represented as a block.

To access a Parametric EQ Control Panel, double click on its signal processing block. The available controls and indicators for the Parametric EQ Control Panel are described below:

EQ Preset Select – Selects a previously stored preset and applies its settings to the PEQ, or saves the current settings as a Preset

EQ Graph – Graphs the current EQ settings.

Load/Save Settings – Loads the settings from a stored .peq file, or saves the current settings as a .

Filter Type – Defines the filter type for the selected filter stage. Available options are PEQ, High Shelf, Low Shelf, Notch, High Pass and Low Pass.

Frequency – Defines the frequency, in Hertz, where the filter is applied.

Q – Defines the Q of the filter for PEQ and Notch filters.

Gain – Defines the amount of boost/cut applied to the EQ stage

Bypass – Bypasses the selected EQ stage
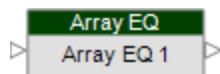
Sort – Sorts the filter stages by Frequency

Q/BW – Switches between Q and Bandwidth

Bypass All – Bypasses all filter stages.

Array EQ

The Array EQ signal processing function provides specialized equalization for RoomMatch® array module loudspeakers. This unique EQ processor may be used as a general purpose room compensation EQ for standard systems.

Block Label – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Array EQ control panel, double click on its signal processing block in the signal processing view. The default state of the Array EQ is Bypass to provide a flat initial response.

The following controls are available within the Array EQ:

Filter Display – Displays a graphical representation of array equalization settings in both frequency and level. The line represents the composite frequency response of chosen array and advanced filter parameters.

Array Parameters – Specifically for use with Progressive Directivity Arrays.

    Module Quantity – Selects the quantity of modules within the array.

    Vertical Coverage – Enters the total vertical angle, in degrees, of the array.

Advanced (Filter Parameters) – The Array EQ is represented by three basic filter controls: Center Frequency, Tilt, and Gain. Using these controls the basic array preset may be modified, or a new array or room EQ may be created.

    Center Frequency – Center frequency of the filter, represented by the dashed line in the Response Graph.

    Tilt – Adjusts the start and end points of the filter's slope on either side of the center frequency. Tilt is adjustable between 0 and 10 in steps of 0.3, the greater the tilt the steeper the filter slope.

    Gain – Amount of boost or cut applied to the filter below the center frequency. Gain is adjustable in 0.3 dB steps between -12 and +2 dB.

Matrix

The Matrix processor routes any input source to one or multiple outputs, or multiple inputs may be routed to a single output. Within the matrix control panel it is possible to apply a cut-only gain to each of the matrix cross points. The output connectors display the output connection status (active or mute).

To access the matrix mixer control panel, double click on its block in the signal processing view.

Input Label – The input label for each input is determined by the input label for the ana-log/digital input. To modify an input label for the router, modify the input label property for the input block.

Output Label – The output label for each output is determined by the output label for the output block. To modify an output label for the router, modify the output label property for the output block.

Assign – Each input is routed, by default, to its corresponding output, 1:1 routing. To route an input to an output select the desired input. Multiple inputs can be routed to a single output
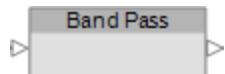
Cross Point Gain – available using a right-click selection at any cross point

Signal Gen. – Indicates the routing of the signal generator. To change the routing of the signal generator use the Signal Generator control panel.

Band-Pass Crossover
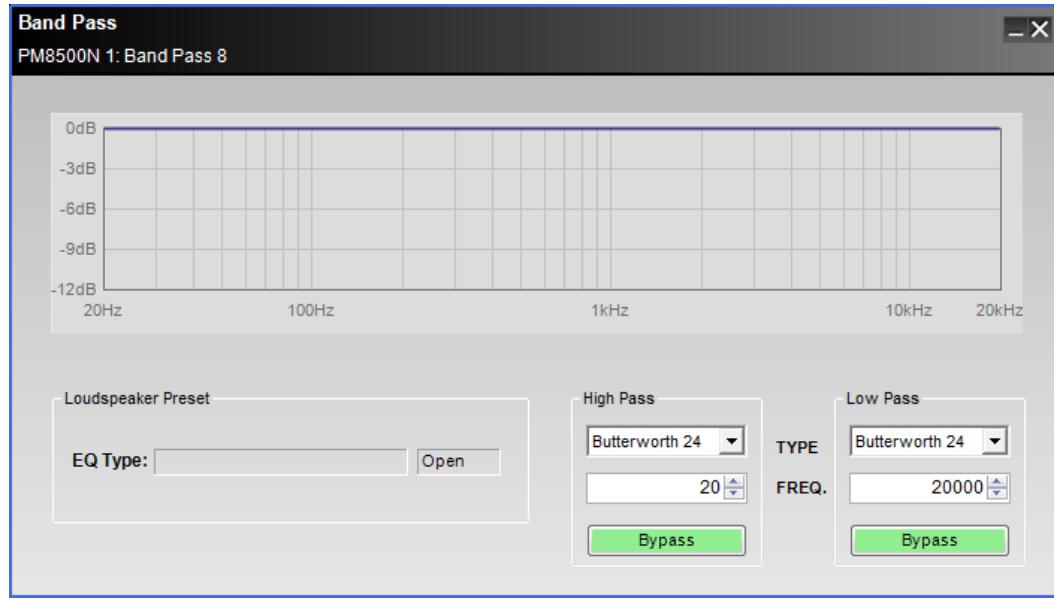
The Band Pass Crossover function provides a single mono crossover for the output signal processing chain. The Band Pass Crossover supports general purpose operation with user defined settings, or provides the loudspeaker specific band pass when a Bose loudspeaker parametric EQ is active.

Within the signal processing diagram the Band Pass Crossover is represented by a single block.

To access the Band Pass Crossover control panel, double click on the block in the signal processing view. The default state of the Band Pass Crossover is Bypass to provide a flat initial response.

The following controls are available within the crossover panel:

Response Graph – Displays the response curve of the High and Low Pass filter settings.

Loudspeaker Preset – When a Bose or custom loudspeaker EQ preset is loaded in the loudspeaker parametric EQ name of the active preset is displayed. Bose loudspeaker presets will cause the band pass controls to be locked. When the controls are locked, "lock" is displayed in the status section next to the EQ Type display.

High Pass Filter Type – Affects the low frequency cut off of the crossover. Available filter types are Butterworth (1st, 2nd, 3rd, 4th, 6th and 8th order), Bessel (1st, 2nd, 3rd, 4th, 6th and 8th order), and Bessel (2nd, 4th, 6th and 8th order).

High Pass Frequency – Defines the corner frequency of the filter.

High Pass Bypass – when active the high pass filter is bypassed.

Low Pass Filter Type – Affects the high frequency cut off of the crossover. Available filter types are Butterworth (1st, 2nd, 3rd, 4th, 6th and 8th order), Bessel (1st, 2nd, 3rd, 4th, 6th and 8th order), and Bessel (2nd, 4th, 6th and 8th order).

Low Pass Frequency – Defines the corner frequency of the filter.
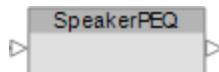
Low Pass Bypass – when active the low pass filter is bypassed.

Loudspeaker Parametric EQ

The Loudspeaker Parametric EQ is a new type of signal processing block which provides either a general purpose 9-band parametric EQ, or a Bose loudspeaker equalization curve. When a Bose loudspeaker equalization curve is active additional settings are applied to the Band Pass Crossover, Delay and Limiter signal processing blocks, and the settings are locked to prevent modification.
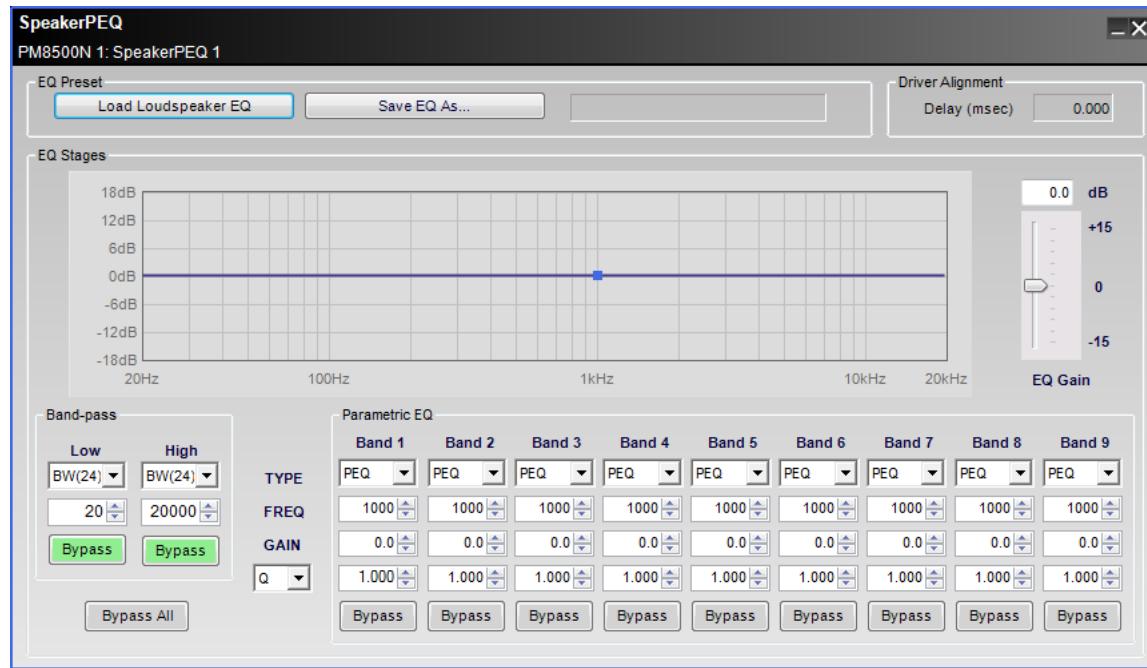
A custom set of loudspeaker settings (Band Pass, Parametric EQ, Delay and Limiting) may be saved as a preset for future use, or a Bose loudspeaker preset may be saved as a starting point for further customization.

Within the signal processing diagram the Loudspeaker Parametric EQ is represented by a single block.

To access the Loudspeaker Parametric EQ control panel, double click on the block in the signal processing view. The Loudspeaker Parametric EQ provides 9 bands of parametric EQ, and provides access to the Band Pass Crossover settings as a convenience.

The following controls are available within the Loudspeaker PEQ panel:

Load Loudspeaker EQ – Displays a "file open" dialog with the Bose loudspeaker EQ directory as the default setting. From within this directory, locate and open the desired loudspeaker preset file.

Once a Bose loudspeaker EQ is loaded into the Loudspeaker PEQ, the settings for the Band Pass Crossover, Parametric EQ stages, Delay and Limiter are disabled to prevent modification, and the name of the loudspeaker EQ preset is displayed.

EQ Type – Displays the name of the loudspeaker EQ which is loaded.

Save EQ As... – Saves the loudspeaker settings (parametric stages, band pass filter settings, limiter settings and alignment delay setting) as a custom file for use in another channel of signal processing or design. The default location for the Save As… function is My Documents.

Driver Alignment – Displays the amount of driver alignment delay used. This is a read-only parameter for Bose loudspeaker EQs.

EQ Graph Display – Illustrates the current response curve that is implemented. Nine grab handles, one for each band, are available and the user may directly adjust the frequency and gain for each band. Note that the graph includes the response of the band-pass filter settings.

EQ Gain - Makeup gain applied post EQ. Up to +/- 15 dB of gain may be applied.

Band-Pass Filters – This section mirrors the controls within the Band Pass Crossover block. Changes made here are reflected in the Band Pass Crossover and vice versa.

Bypass All – bypasses all PEQ bands and band pass filters.

Parametric EQ Bands – Nine bands of parametric EQ are available. Each band contains the following functions:

    TYPE - Filter Type: PEQ, High Shelf, Low Shelf or Notch

FREQ - Center frequency of filter in Hertz.

GAIN - Gain of filter in 0.5 dB steps between +20 dB and -20 dB.

Octave (Bandwidth)/Q - Selects between 0.14 and 6.67 Octaves in .01 Octave steps (filter Q between 0.1 and 10). A user selection is available to change the display and data entry between Octave (Bandwidth) and Q.

**Bypass** - Bypasses the selected EQ band.

Limiter

A Limiter provides both peak and RMS voltage limiting for loudspeaker driver protection.

NOTE: The limiter block is shown in the processing diagram before the output gain stage, but functionally, the output gain is pre-limiter to provide proper operation.

The limiter may be used as a general purpose peak and RMS limiter. In this application, the peak voltage should be set to prevent over-excursion of the driver, and the RMS limiter should be set to the power handling of the driver; both the peak and RMS values are entered in Volts.
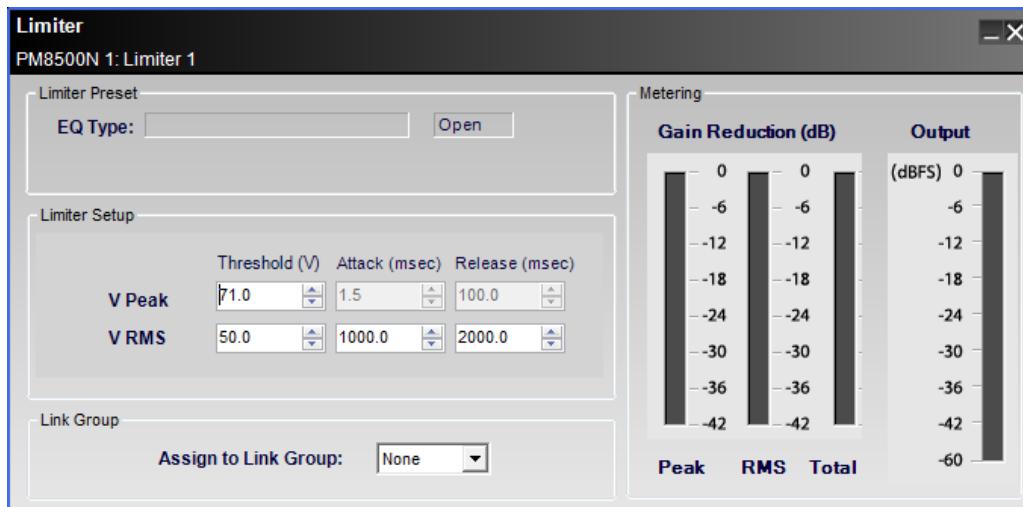
When a Bose loudspeaker preset is active, the limiter settings are specific to the Bose loudspeaker, and the settings are visible but may not be adjusted.

Within the signal processing diagram the Limiter is represented by a single block.

To access the Limiter control panel, double click on the block in the signal processing view. The Limiter provides Peak and RMS limiting, a linking function, and metering of the Peak and RMS limiting, as well as the channel output level.

The following controls are available within the Limiter panel:
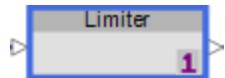
EQ Type– Displays the currently selected loudspeaker equalization curve within the Loudspeaker EQ processing block.

Peak Voltage Limiting – The Peak Voltage Threshold defines the behavior of the Peak Voltage limiter and corresponds to the maximum voltage which may be applied to the driver without causing over-excursion. The read-only attack and release times are shown.

RMS Voltage Limiting – The RMS limiter behavior is defined by the RMS Voltage settings: Threshold(V), Attack (msec) and Release (msec).

Link Group – The limiter may be assigned to one of four link groups, or may act independently (no assignment). When channels are linked the presence of limiting on any of the linked channels engages the limiter on all linked channels.

When Limiters are linked, their signal processing block displays the Limiter Link Group assignment as shown:

Metering – Meters display the amount of gain reduction, in dB, for both the Peak and RMS limiters. A third meter displays the total gain reduction (the greater of either Peak or RMS), in dB, being applied to the signal. An output gain meter is included to assist in the set up and configuration of the limiter.
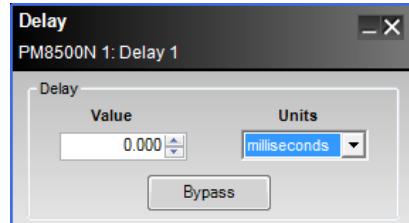
Signal Delay

A signal alignment delay is provided to accommodate cluster or zone signal alignment. A secondary delay is indicated for Bose loudspeaker signal processing which may not be modified.

Within the signal processing diagram the Delay is represented by a single block.

To access the Delay control panel, double click on the block in the signal processing view. The Delay provides up to 2 seconds of signal delay per output channel. The following controls are available within the Delay panel:

Value – Amount of signal delay applied based on the selection within the Units drop down list.

Units – The method used to determine the amount of signal delay. Available selections are: milliseconds, sample, meter, millimeter, feet, and inch.

Output Attenuation

The Output Attenuation block provides control over the amplifier output for the PowerMatch amplifier. Control of the output attenuation is available for each of the eight outputs, based upon the current output configuration, and is accomplished using the output Control Panel. Within the signal processing view each output is represented as a block.
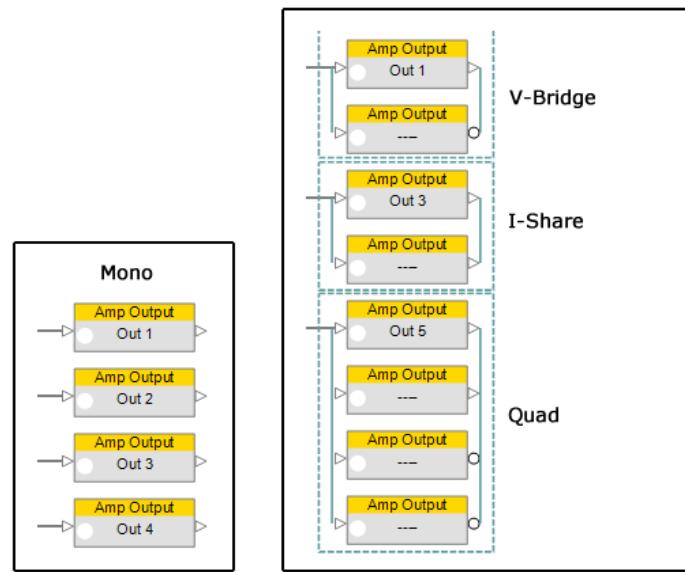

Output Label – Default label is "Out n", and may be modified while off-line.

Output Connection – Displays the output connection status (active or mute), and is not user accessible (i.e. the user cannot "wire" this output to another input).
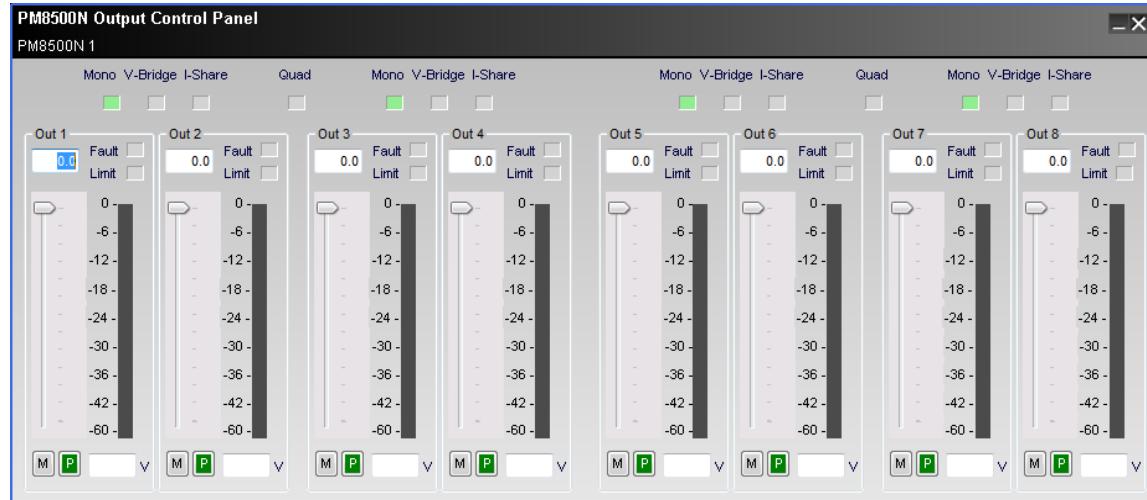
Output Signal Level Meter – Displays the current input signal level as green, yellow, orange or red.

Output Configuration – The current output configuration is displayed as either individual/mono, Voltage Bridge, Current Share or Quad Bridge.

To access the Output Attenuation control panel, double click on any of the Output blocks in the signal processing view. Each of the output channels is available on the Output Attenuation control panel.

The following functions are included for each output control:

Output Mode Indicators – Displays the current output configuration for each channel pair. The following are the valid configurations:
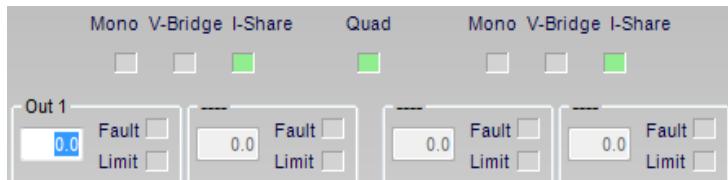
   Mono - Configured for independent channel operation

   V-Bridge – Configured for voltage bridging operation, 2x Voltage output. This configuration may drive a low impedance, 4 or 8 Ohm, or high impedance, 70 or 100V.

   I-Share – Configured for current sharing operation, 2x output current. This configuration may drive a low impedance, 2 or 4 Ohm, only.

Quad – Configured to use four channels simultaneously to provide 4x the output Voltage. This configuration may drive a low impedance, 4 or 8 Ohm, or high impedance, 70 or 100V.

When configured for Quad bridge, the two channel pairs are both configured for current sharing operation, and the Quad Bridge indicator is present as shown:

Output Channel Label – Default channel label is "Out n" and can be modified when offline. Channels used for Bridge or QuadBridge operation are shown with a "---".

Fault Indicator – Indicates the present of a fault condition within the amplifier channel. Clicking on the Fault indicator displays the Alarm Panel. From here, details about the fault condition can be viewed, and the fault may be cleared.

Output Protection Limit Active Indicator – Illuminates yellow when any of the following amplifier protection mechanisms are engaged: Peak or RMS Voltage limiter active, gain reduction due to amplifier temperature, gain reduction due to power supply temperature.

Output Channel Attenuation – Displays the output attenuation between 0 dB (full gain) and -infinity dB. This is a user-accessible display where the user may enter a numeric value using a -00.0 format.

Output Channel Attenuation Slider – Attenuates the output gain between 0 dB (full gain) and -infinity dB.

Output Channel Signal Level Meter – Displays the current output signal level and is scaled to 0 dB (full gain) and -80.

Output Channel Mute – When active, mutes the output of the selected channel.

Output Channel Signal Polarity – When active, reverses the signal polarity.
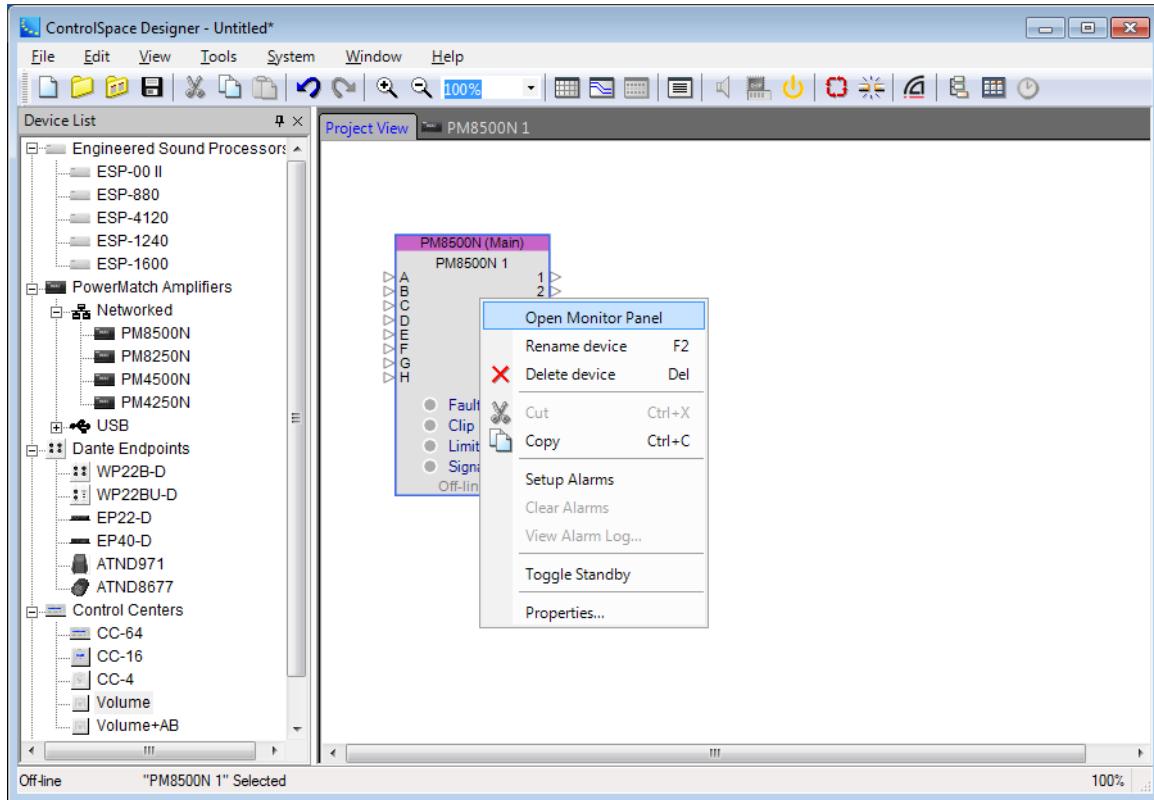
Output Voltage Display – Displays the current output voltage of the amplifier channel.

PowerMatch Monitor Panels

Two types of monitor panels are available for the PowerMatch amplifiers:

- A full size monitor panel which displays the status of inputs, outputs and faults, as well as provides the ability to put the unit into standby
- A small amplifier status panel which is displayed when the system status function is enabled

To access a PowerMatch amplifier's monitor panel, select **Open Monitor Panel** from the right click menu of the PowerMatch amplifier within the Project View.

The full size PowerMatch monitor panel provides an overview of the current operational status of the device, and a control to place the amplifier into/out of standby.

From within the PowerMatch amplifier's monitor view, the following functions are available:

Input Status – Displays the currently active input source (Analog/Digital), the Input Card type, and the input signal level for each of the eight inputs (A to H).
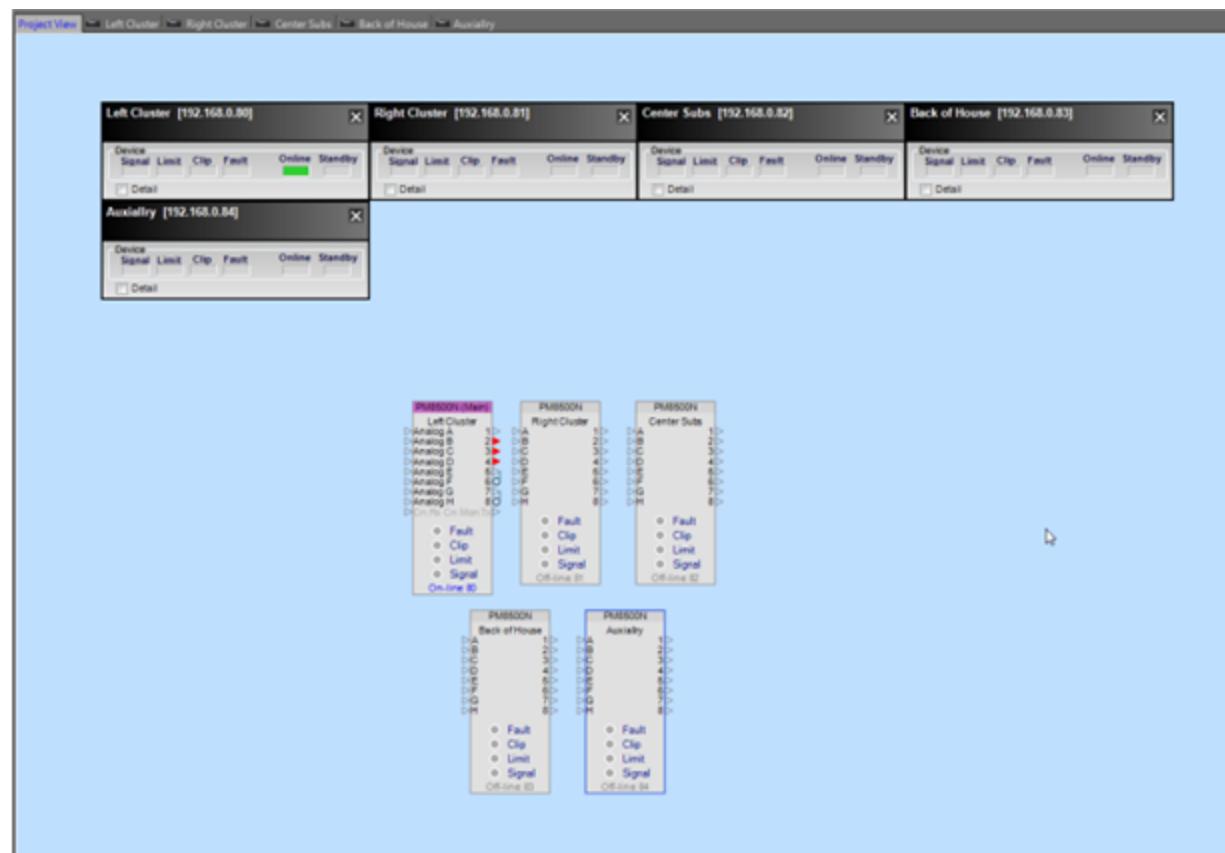
Mute All – Mutes all output channels.

Enter Standby – Toggles the standby state of the amplifier
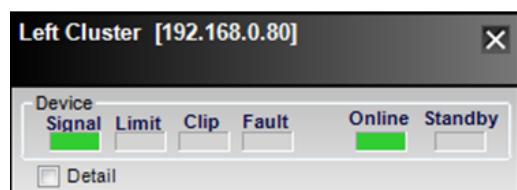
Output Status – Displays the output status for each output of the amplifier. Included indicators are the output label, channel configuration, channel alarm status, limiting/protect status, the current output signal level, and an output mute.

When the System Status Settings (**AutoTile Layout** and **Collapsed View**) are enabled in the **View** menu, the amplifier status panels for all PowerMatch amplifiers are displayed according to the selected settings.
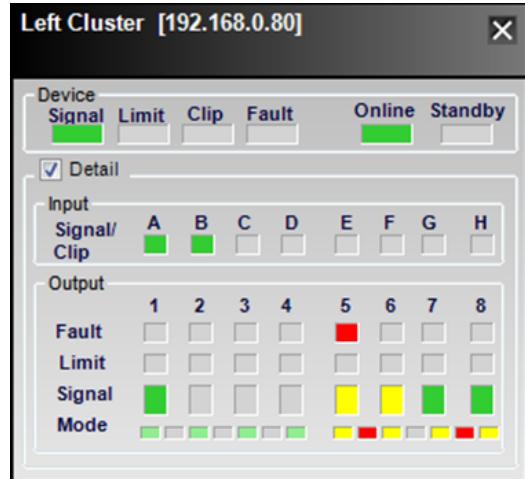
To access the System Status function, select the system status icon [icon] while on-line and connected to the system.
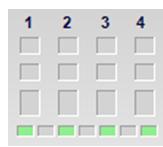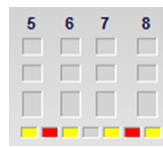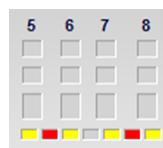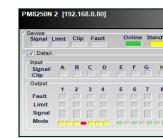
Each amplifier status panel is displayed using either a collapsed or expanded view. In the collapsed view only the primary status indicators are available.

Select Detail to expand the amplifier status panel to see all of the amplifier's status indicators.

Indicator	Status
Signal	Green when input signal level is present on any input channel.
Limit	Yellow, when any output limiter is active.
Clip	Red when input clipping is present.
Fault	Red when an alarm condition is active. See the alarm properties within the device properties to configure which alarms conditions will activate this indicator.
Online	Green when device is online
Standby	Green when device is in standby
Input Signal Level (channel)	Green, Yellow, Red based on input signal level.
Output Fault (channel)	Red when an alarm condition exists. Click on the Fault indicator to view the amplifier alarm panel. Note this displays all alarms, regardless of the settings within the device properties.
Output Limit (channel)	Orange when output limiter is active.
Output Signal (channel)	Green, Yellow, Red based on output signal level.
Output Mode (channel)	Each of the four operation modes is represented using the mode indicators as follows:

Indicator	Status		
	Mono	V-Bridge	
	I-Share	Quad	

Working With Alarms

Each PowerMatch® amplifier monitors its operation for proper operating temperature, power supply status, amplifier status, open and short wiring, as well as additional alarm conditions. This information is stored locally in an internal log of all alarm conditions, and information from the alarm log may be viewed using the ControlSpace® Designer™ software.

In systems where the ControlSpace Designer software is connected to the devices, either via USB or Ethernet, the time and date of the alarm condition is appended to the alarm.

Alarm Summary

The PowerMatch amplifiers monitor the following alarm conditions:
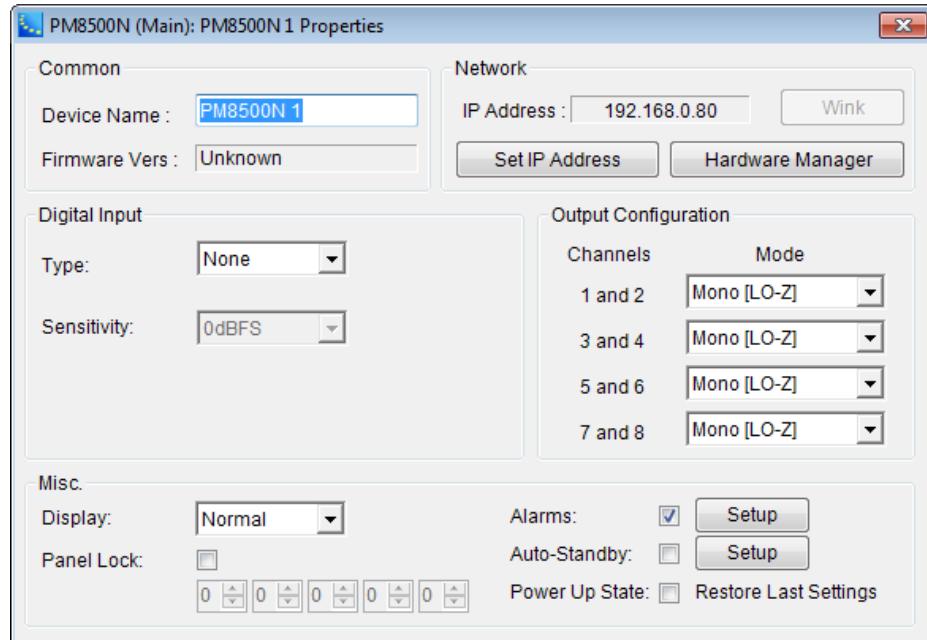
Category	Alarm Condition	Description
Gain Reduction, Signal Limiting	Limiter Active due to high output current	Protection limiter engaged for any output channel.
Output Fault	Open Circuit	An open circuit, output impedance is greater than 20 Ohms.
Output Fault	Short Circuit	A short circuit detected on an output – output impedance is less than 1 Ohm. This alarm condition is always active and may not be disabled.
Input Fault	Input Clipping	Input Signal Clipping
Input Fault	Loss of Digital Audio Source	Digital audio source expected, but digital audio source is not operational.
AC Power Fault	Loss of AC Power	

For a complete list of PowerMatch amplifier fault conditions, see the PowerMatch Installation Guide at Pro.bose.com.

Fault Output Configuration
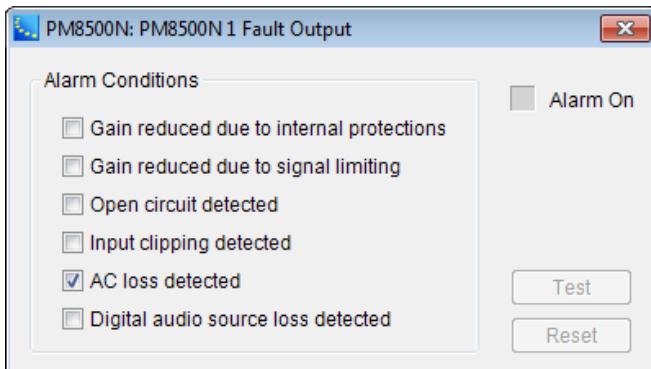
The PowerMatch amplifier includes a hardware fault output capable of driving a normally open, or normally closed contact closure, 1A, 30 VDC maximum. The fault output is intended to provide an external connection to a remote system monitor for fault notification purposes.

The fault output must be enabled for operation, and must have alarm conditions defined which will trigger its operation. This is accomplished from within the Properties Panel of the PowerMatch amplifier.

Enable Alarms – when alarms are enabled the selected alarm conditions will trigger the fault output and front panel fault LED.

Setup Alarms – select this item to determine which alarms will trigger the front panel LED and fault output. When selected the Alarm Conditions dialog is displayed.

From within the Alarm conditions dialog you may select which alarm types will trigger the hardware Fault Output and front panel Fault LED. By default the only alarm condition selected is the AC Power Loss alarm.

Alarm Conditions – The state of an alarm condition determines how the alarm will be logged, and reported via the Fault Output, front panel Fault LED, and within the ControlSpace Designer software. The following table summarizes the reporting and display for each alarm condition based on its selected state.

[insert table of alarms]

Alarm ON Indicator – indicates the presence of an alarm condition.

Alarm Test – available when online with the PM8500, selecting Test will trigger the Fault Output and Front Panel LED.

Alarm Reset – available when online with the amplifier, selecting Reset will reset the Fault Output and Front Panel LED.
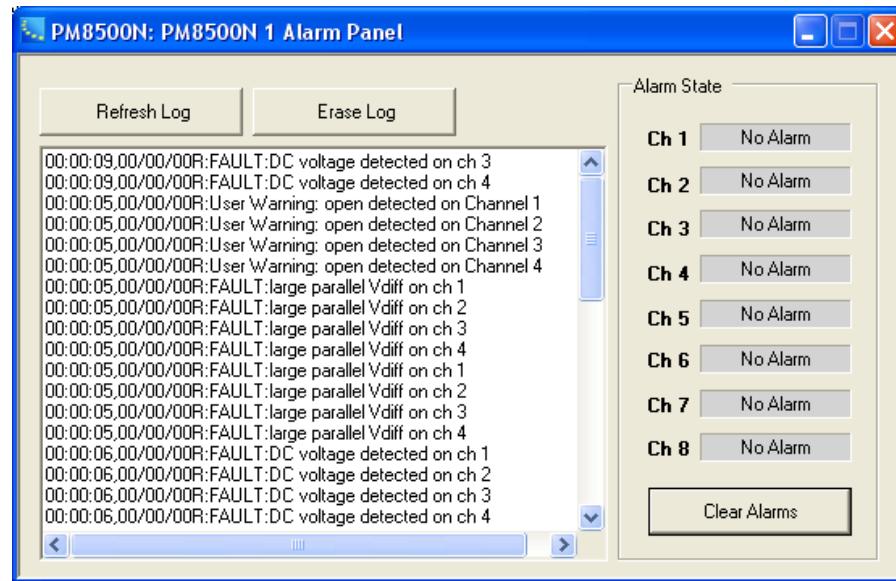
Viewing the Alarm Log

Upon connection to the PowerMatch amplifier the ControlSpace Designer software automatically retrieves the alarm log from the hardware. The alarm log may be accessed from a variety of locations from within the Power-Match amplifier interface.

To access the amplifier alarm log, use one of the following options:

- In the Project View, select **View Alarm Log** from within the right-Click context menu for the amplifier.
- Click on the **Fault** indicator within the Monitor Panel for the amplifier.
- Click on the **Fault** indicator within the Output Control Panel for the amplifier.

Once you have accessed the amplifier alarm log, the alarm log panel is displayed:

From within the Alarm Log Panel you can view, copy, erase and clear alarms. The following functions are provided:

Refresh Log – Updates the alarm list to display the most recent alarms that have occurred.

Erase Log – Clears the alarm log from both the software and hardware.

Alarm List – Displays the list of alarms which have occurred. Alarms are suffixed with either "R" or "A." "R" indicates a relative time as recorded by the hardware, and "A" indicates the actual time the alarm occurred. Alarms suffixed with "A" occurred when ControlSpace Designer software was connected to the system.

Alarm State – Displays the current alarm state of each output channel.

Clear Alarms – Clears the alarms within the hardware. Also clears the Fault Output and front panel Fault LED.
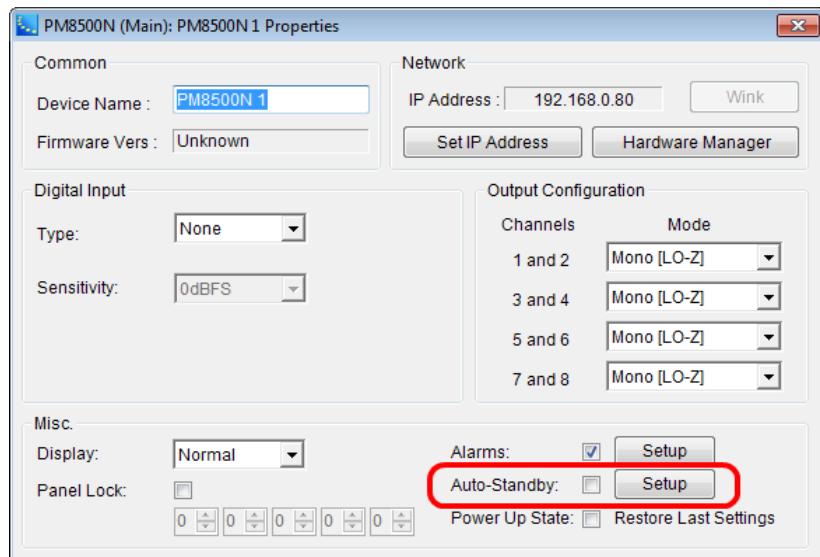
Working with Auto-Standby

The Auto-Standby function detects the presence of an input signal on any available input channel. When Auto-Standby is active, the absence of an input signal for a specified time period causes the unit to place itself into Standby.

This function is available in all PowerMatch® amplifier models.
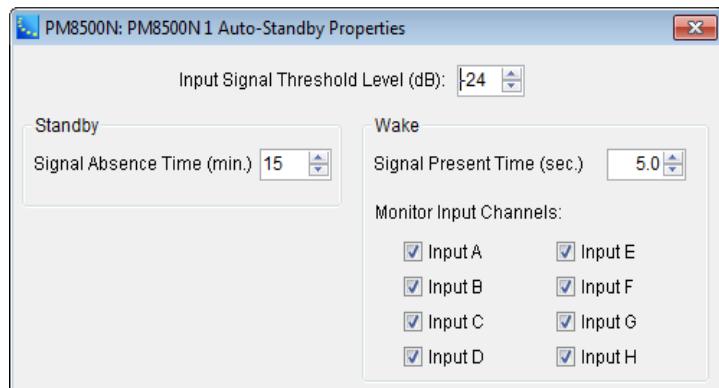
To set up the Auto-Standby function:

1. Select a PowerMatch amplifier in the Project View and open its Properties dialog:

2. Click on the **Auto-Standby** check box to enable the Auto-Standby function and then click the **Setup** button. This opens the Auto-Standby configuration dialog:

Input Signal Threshold (dB) – the level (−24 to −60 dB) below and above which the Auto-Standby timer begins counting to place the amplifier into and take the amplifier out of standby.

Signal Absence Time (minutes) – the amount of time (15 min to 12 hrs in 15-min steps) that the signal must be below the threshold before the amplifier puts itself into Standby.

Signal Present Time (sec) – the amount of time (5 to 60 sec, in 5-sec steps) that the signal must be above the threshold before the amplifier comes out of Standby.
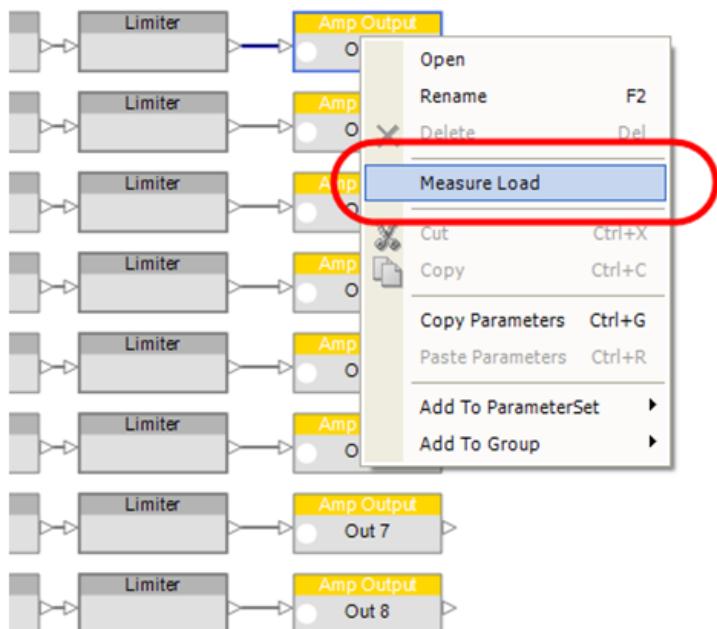
Monitor Input Channels – allows you to choose the which input channels will be monitored for signal to bring the unit out of standby.

Measuring Loudspeaker Impedance
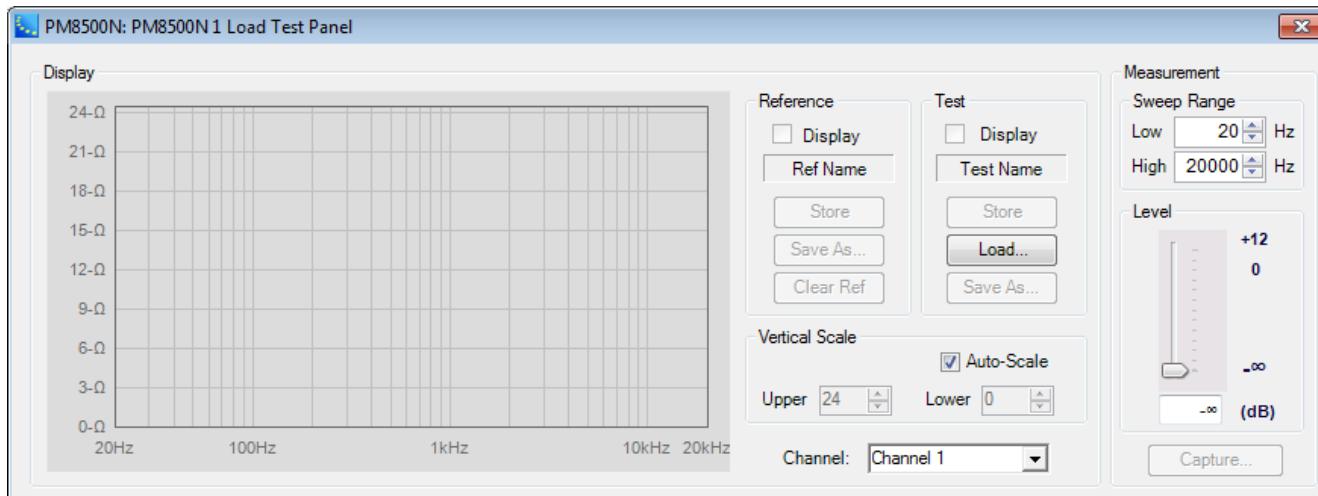
A load measurement function is provided to measure the load impedance of each PowerMatch amplifier output for system diagnostic and documentation purposes. The load measurement function inserts a test signal into the output signal processing chain and measures the output load impedance and current across a defined frequency range. The result of this measurement is displayed as a frequency vs. impedance graph.

The load measurement can be stored as a reference for the final system installation, and subsequent measurements may be compared to the reference to determine if the system is still operating as expected. Differences between the reference curve and a subsequent measurement can be indicative of wiring or transducer damage. The load measurement function cannot pinpoint the cause of the problem, but can indicate that a problem exists between the output of the amplifier and the transducer.

The load measurement function is accessed from within the Signal processing Viewfor the PowerMatch amplifier using the right-click context menu for any of the amplifier outputs.

Selecting "Measure Load" from the right-click context menu displays the Load Test Panel:

From within the Load Test Panel the following functions are available:

Impedance vs. Frequency Graph – Displays the current measurement, the reference and one additional measurement simultaneously.

Channel – Controls the output under test. The default is determined by the output block selected when the Load Measurement was invoked, but all outputs are available for selection.

Sweep Range – Determines the frequency range to be measured.

Output Level – Controls the output level of the signal generator. Always begin with a low output level to prevent any damage to system components.

Capture – Initiates the load measurement. The built-in signal generator is routed to the selected output and the measurement is active. Once the measurement is complete, the previous routing for the output under test is restored, and the impedance vs. frequency data is displayed.

Reference Display – Enables the display of the stored reference measurement for the selected channel.

Reference Name – Displays the user defined name of the reference measurement.

Reference Store – Stores the current measurement as the reference for this channel. When selected you have the option to name the reference curve. The reference is stored with the ControlSpace Designer file (.csp) for future reference.

Reference Save As... - Exports the reference curve as a text file for use in other applications.

Measurement Display – Enables the display of the stored reference measurement for the selected channel.

Measurement Name – Displays the user defined name of the measurement.

Measurement Store – Temporarily stores the current measurement for display in the Impedance vs. Frequency graph. To save the measurement for future use select Save

Measurement Load – Opens a previous saved measurement file for display within the Impedance vs. Frequency graph.

Measurement Save As... – Exports the measurement curve as a text file for use in other applications.

Vertical Scale, Auto-Scale – Automatically determines the upper and lower impedance limits and scales the graph accordingly.
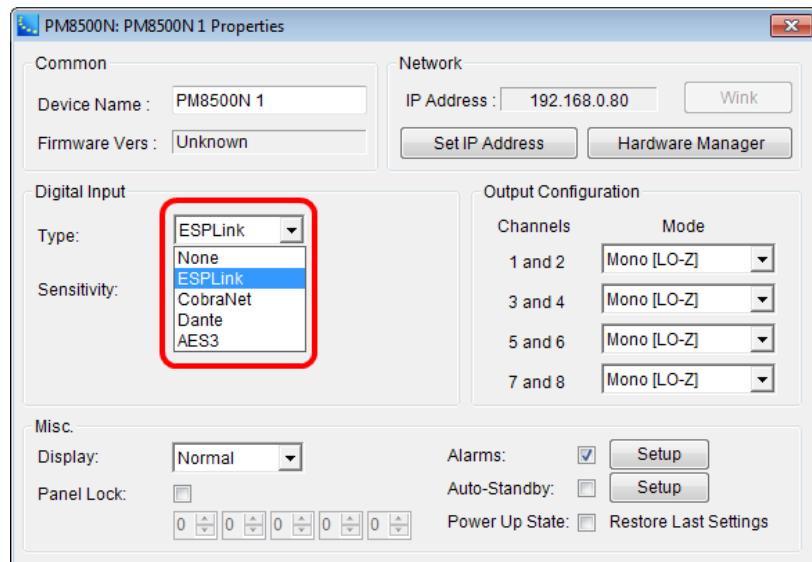
Vertical Scale, Upper – Adjusts the upper limit of the Impedance scale.

Vertical Scale, Lower – Adjusts the lower limit of the Impedance scale.

Expansion Cards
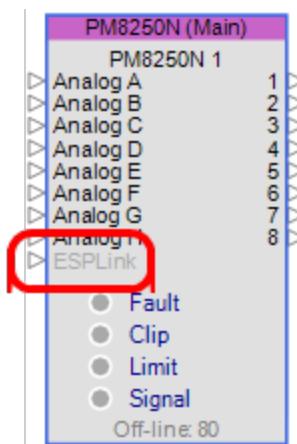
ESPLink 8-Channel Input Card

The ESPLink accessory card installs into the digital input slot of the PowerMatch® amplifiers. It receives eight digital audio channels from a ControlSpace® ESPLink output card. An optical cable is included.

ESPLink card selected in PM8250N Properties

After selecting the ESPLink card, the Project View icon for the amplifier displays the ESPLink input connections.

PM8250N icon with ESPLink inputs
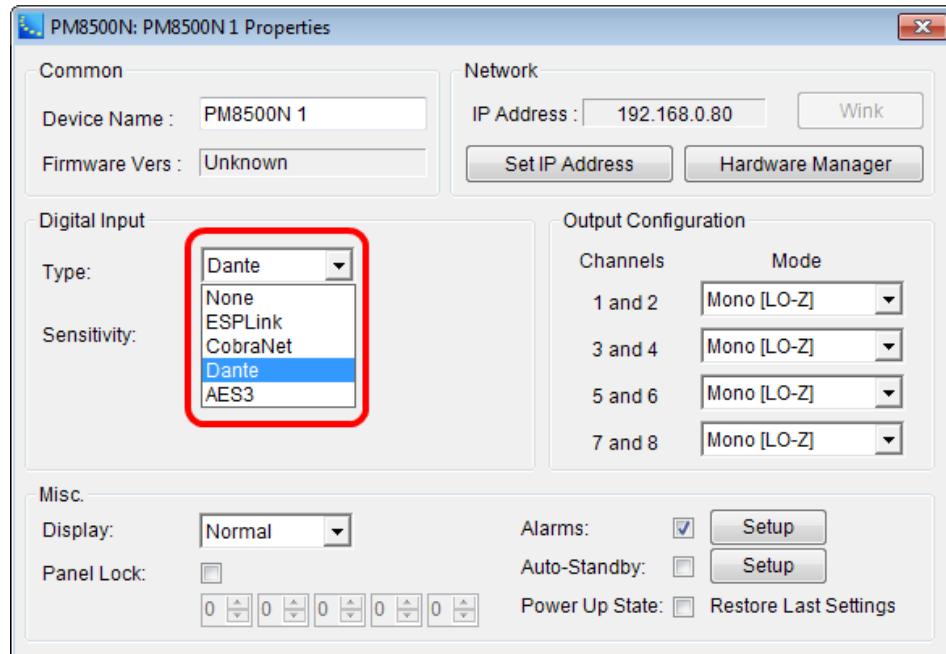
Dante™ Network Card

The Bose PowerMatch® configurable amplifiers, PM8500/8250/4500/4250, are capable of supporting up to 16 channels of high quality, uncompressed digital audio from a Dante digital audio network in a 8x8 configuration.

Defining the Dante™ Card Configuration
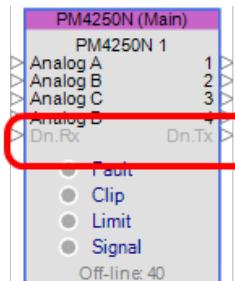
The Dante digital audio network card is added to the PM8500/8250/4500/4250 in the same manner as other expansion cards. If the card has already been fitted it will be detected automatically when a hardware scan is performed. Otherwise, the card can be added manually to the system design as follows:

Right-click on the PM8500/8250/4500/4250 icon in Project View and select Properties to display the amplifier Properties dialog box. Select the Dante option from within the Digital Input drop-down list.

Dante Digital Audio Network Card option within PM8500/8250/4500/4250 Properties
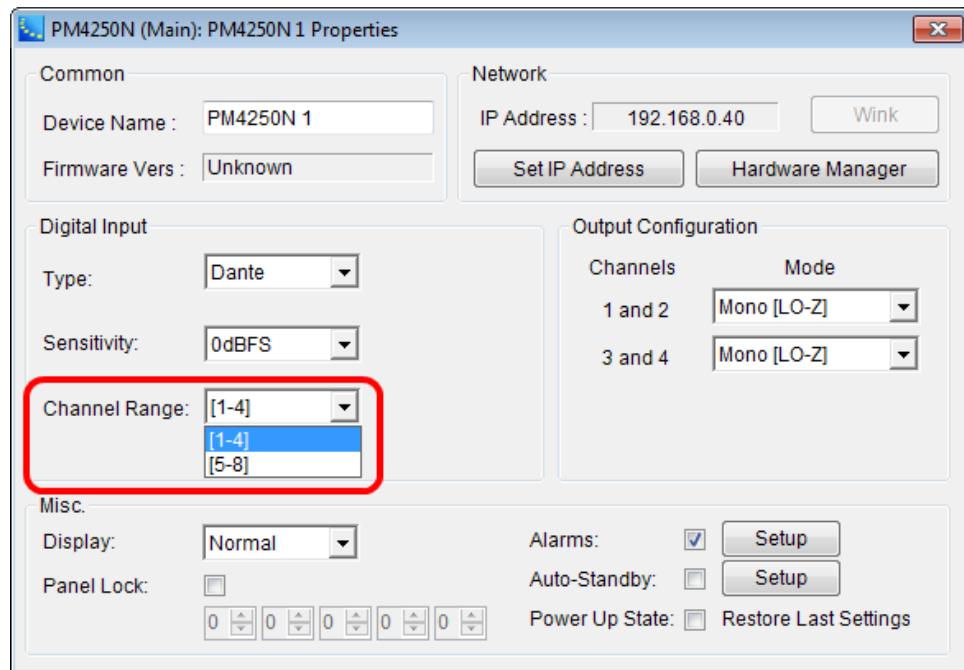
After selecting the Dante network card, the Project View icon for the amplifier displays the Dante input/output connections.

PM4250 icon with Dante input/output

Channel Selection (4-Channel Models Only)

PowerMatch amplifiers are capable of receiving 8 channels, or a single Flow, from a Dante digital audio network. When working with a four-channel PowerMatch amplifier it is possible to select between the two groups of four channels, channels 1-4 or channels 5-8, as the input source. This selection is made using the Channel Range drop-down list.

Digital Input Channel Range selection within PM4500/4250 Properties

.

For information on the Dante global properties control panel, see Dante™ Network Card Properties.
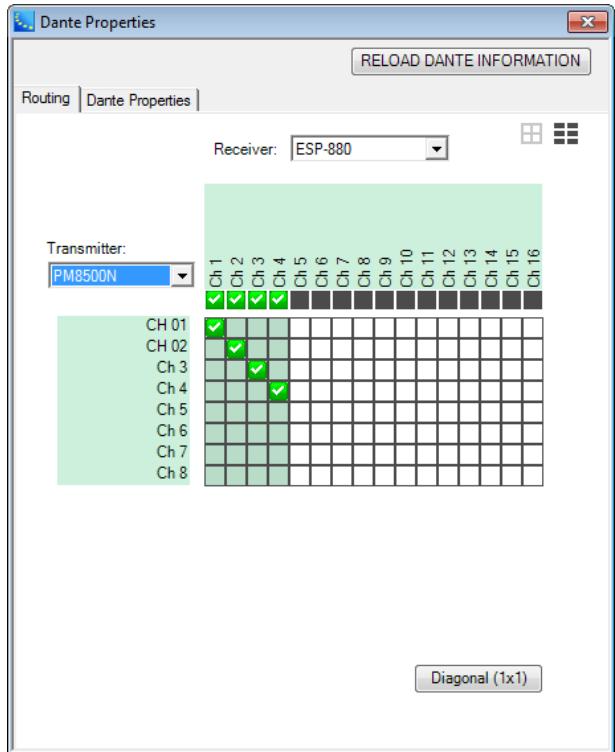
Configuring the PowerMatch Dante™ Card Audio Monitor Bus

The PowerMatch Dante digital audio network card is capable of transmitting 8 audio channels for use as an audio monitor. In some situations amplifiers are remotely located, and this function may be used to remotely monitor the audio being sent by the amplifier to the loudspeaker.

Audio from the DSP output for each channel is routed directly to the Dante transmit bus where it is available to be sent to other Dante receiving devices.

NOTE: This is a "post-processing" signal, that is, after all the DSP processing. If, for example, the output is muted, then the monitor signal is muted as well.

To enable the audio monitor bus, you must use the Routing function in the Dante Card Properties to configure the channel routing for the Dante network when sending audio from the PowerMatch Dante card.
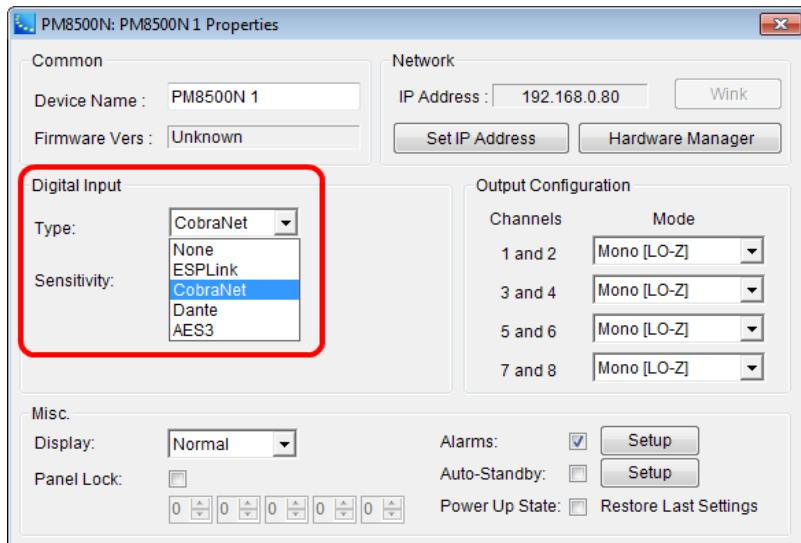
Network audio routing of monitor bus for PowerMatch amplifiers (PM8500 shown)

CobraNet® Network Expansion Card
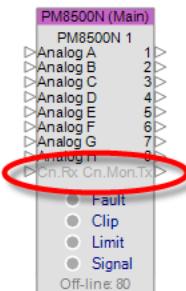
The PowerMatch® CobraNet® card inserts into the digital input card slot of Bose® PowerMatch amplifiers and provides a up to 16 channels, (8 input and 8 output), of uncompressed 48 kHz digital audio using CobraNet audio networking. Designed for "plug and play" operation with the ControlSpace ESP CobraNet card, the PowerMatch CobraNet card provides a cost-effective means of distributing audio to multiple remote amplifiers.

To configure a PowerMatch amplifier for operation with a CobraNet input card, select the CobraNet option from within the list of available digital card types within the amplifier's Properties.

PowerMatch amplifier Properties – select CobraNet for Digital Card type
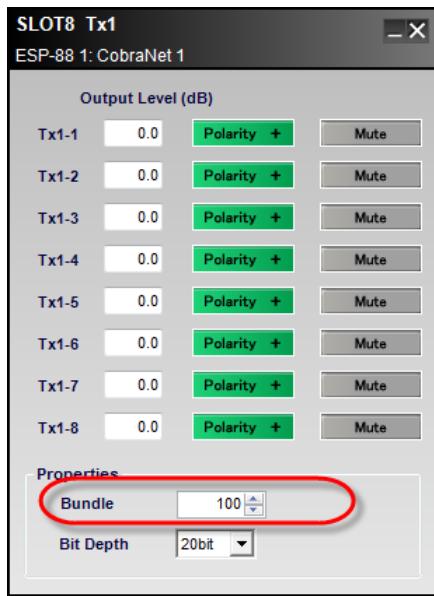
Once the PowerMatch CobraNet card is selected the Project View icon for the amplifier displays a CobraNet input, and CobraNet output connection.

CobraNet I/O shown on the Project View icon

The PowerMatch CobraNet card ships preconfigured to receive 8 channels of audio on Bundle number 100, while the audio monitor bus is disabled. When configuring the system for operation with a ControlSpace ESP CobraNet card use the following steps:

1. Configure the ESP for use with a CobraNet card. The configuration should include, at a minimum, 8 channels of CobraNet audio output.
2. Configure the amplifier for operation with a CobraNet input card.
3. From within the ESP-88 signal processing view, select the CobraNet output control panel.
4. Assign the Transmit bundle to bundle address 100.

CobraNet bundle assignment within the ESP

5. Route audio to the CobraNet outputs.

    At this point you will have successfully routed audio from the ESP to a PowerMatch amplifier.

NOTE: The ControlSpace Network and CobraNet audio network must be physically separate networks using separate routers/switches. However, if you are using a managed switch you can configure the CobraNet audio network to use a dedicated VLAN for CobraNet network traffic.

For information relating to recommended network set up and design practices for CobraNet audio see www.CobraNet.info.

Configuring the PowerMatch CobraNet Card Audio Monitor Bus

The PowerMatch CobraNet® is capable of transmitting 8 audio channels for use as an audio monitor. In some situations amplifiers are remotely located, and this function may be used to remotely monitor the audio being sent by the amplifier to the loudspeaker.

Audio from the DSP output for each channel is routed directly to the CobraNet transmit bus, where it is available to be sent to other CobraNet receiving devices.
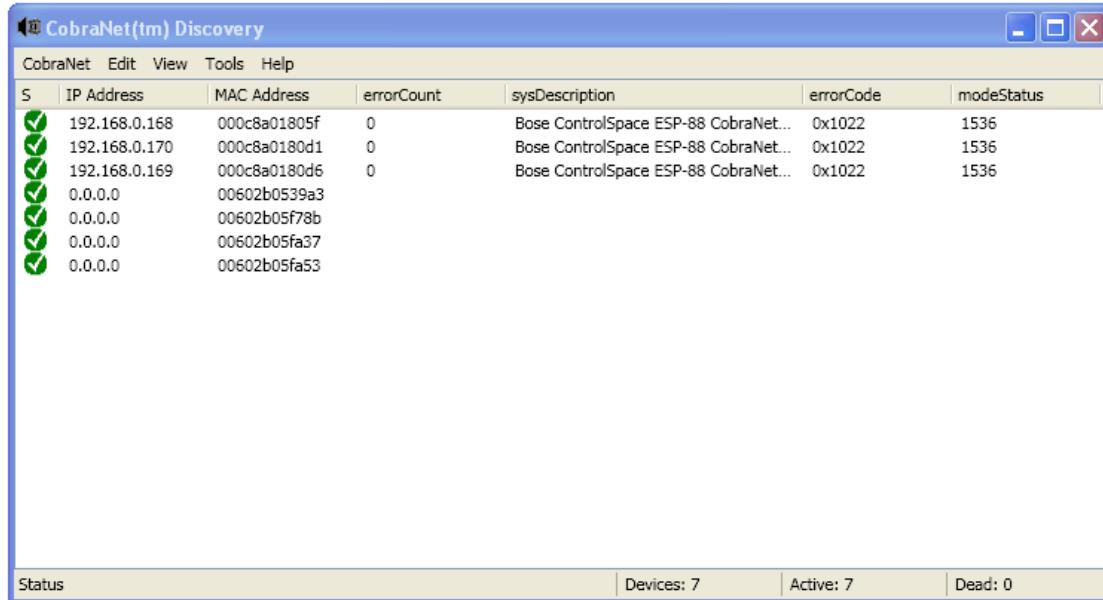
NOTE: This is a "post-processing" signal that is after all the DSP processing. If, for example, the output is muted, then the monitor signal will be muted as well.

The default bundle assignment is 0, indicating that the audio is not being placed on the larger network. To enable the audio monitor bus you must use CobraNet Discovery to configure the PowerMatch CobraNet card.

NOTE: CobraNet Discovery is available at www.CobraNet.info.

To configure the PowerMatch CobraNet card audio monitor bus, use the following steps:
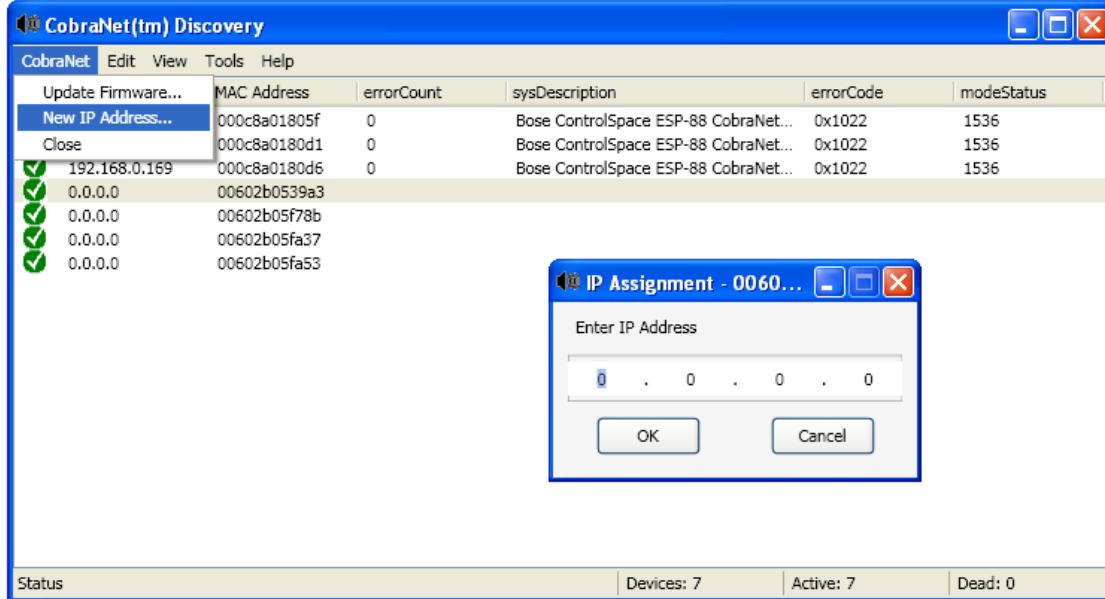
1. Ensure that your network adaptor is correctly configured and connected to the CobraNet network, rather than the ControlSpace network.

2. Launch CobraNet Discovery – any CobraNet devices will be discovered.

CobraNet Discovery interface
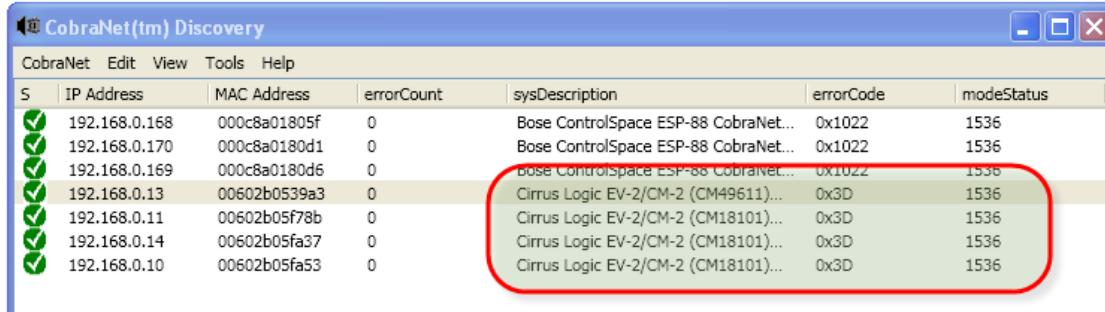
3. It will be necessary to configure the PowerMatch devices with an IP address to configure the CobraNet settings. Select one of the devices within the device list, and choose New IP Address from the CobraNet menu. Altern-

atively you can configure CobraNet Discovery to automatically assign devices an IP address. To do this select the Enable Auto Assignment option within the CobraNet Discovery Options dialog.
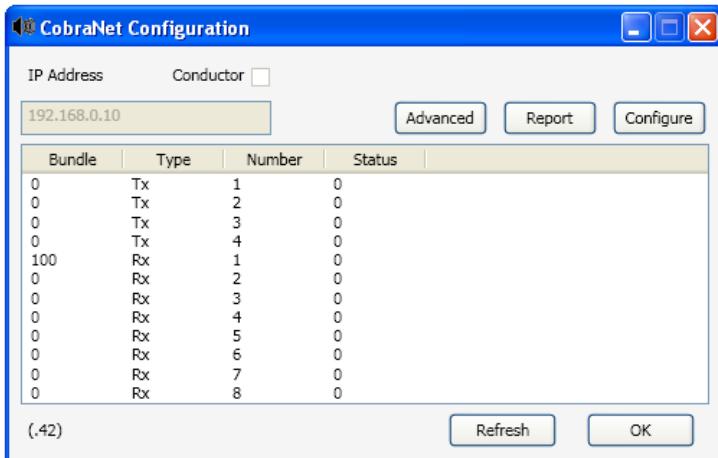
Assign an IP address to CobraNet devices.

Once IP addresses are assigned the device list is refreshed and details about the device's configuration are displayed.
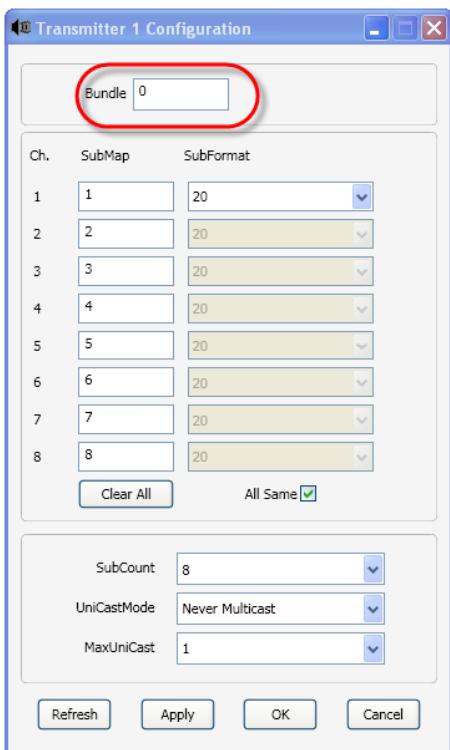
CobraNet device list showing device properties

4. Select one of the PowerMatch amplifiers and select "Configure" from the Tools menu. This will cause the configuration settings for the device to be displayed:

CobraNet configuration for a PowerMatch amplifier

5. From within the Configuration settings panel select the first Tx bundle and click "Configure" to display and configure the Transmit bundle settings. Enter a bundle assignment for the Transmit bundle. Bundles 1-255 are Multicast bundles, and bundles greater than 256 are:

Bundle assignment for PowerMatch amplifiers

NOTE: We recommended that you use Unicast bundle assignments to better manage network bandwidth.
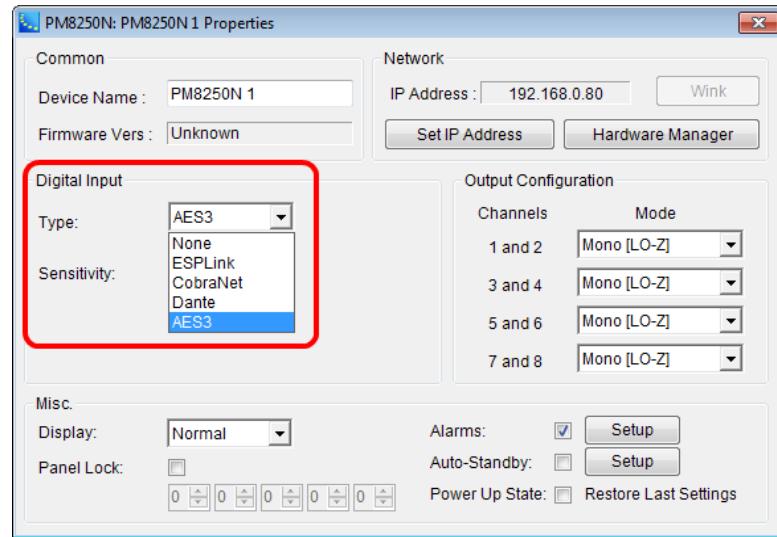
6. Set the receive bundle of the receiving CobraNet device to the same as the amplifier transmit bundle.

For additional information and application examples related to the set-up and configuration of Bose system electronics which employ CobraNet network audio see http://pro.Bose.com. Application notes are available within the ControlSpace® Designer™ software area of the site.

AES3 Digital Input Card
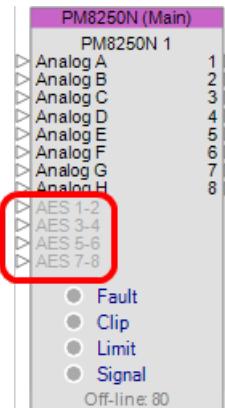
This expansion card provides a PowerMatch® amplifier with eight channels of AES3 digital audio input.

To configure a PowerMatch amplifier for operation with an AES3 digital input card, select the AES3 option from within the list of available digital card types within the amplifier's Properties.
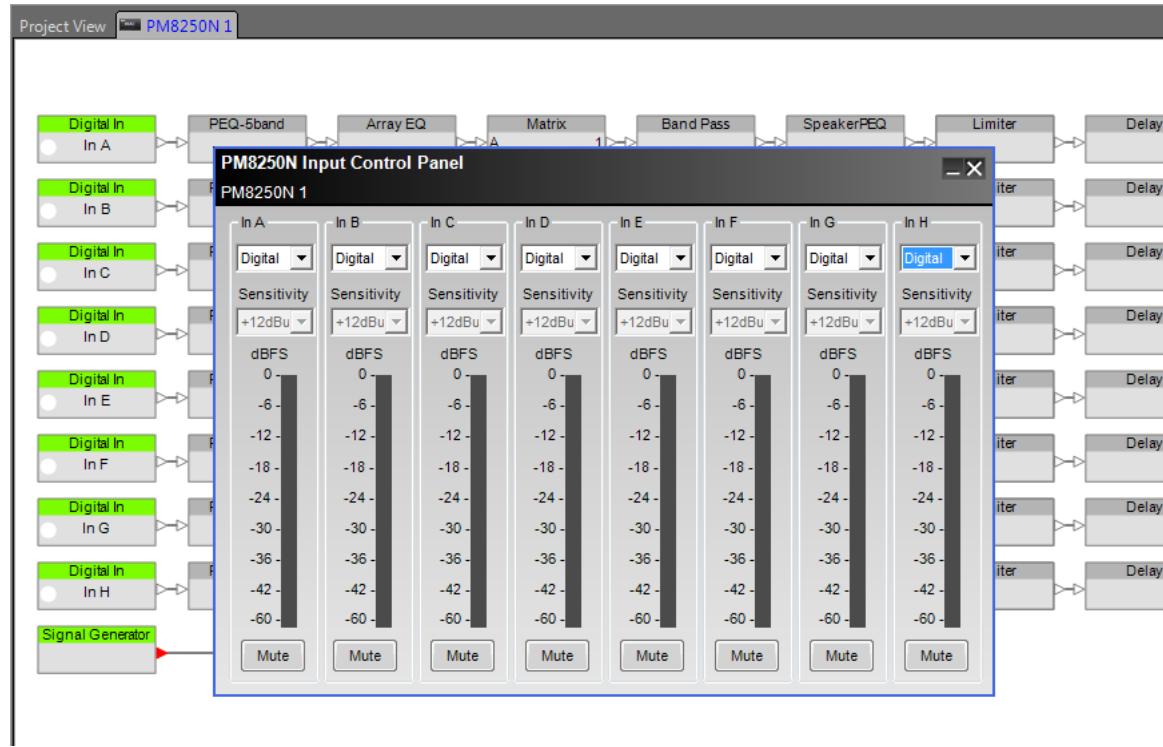
AES3 card selected in PM8250N Properties

After selecting the AES3 card, the Project View icon for the amplifier displays the AES3 input connections.

PM8250N icon with AES3 inputs

Adjustable options for this card are accessed by double clicking on any input block within the signal processing view to open the control panel.

AES3 eight-channel input card control panel

The **Input Control Panel** provides the following options for each channel:

    Input Channel Label – Default channel label is "In n" and reflects the label applied in the Signal Processing view.

    Input Source Select – Select the desired input source – analog or digital for each input. The digital selection is available when an AES3 input card is installed.

    Input Channel Sensitivity – (Analog inputs only.) Select the desired input signal level to drive the Power-Match amplifier to its full output. Digital input sensitivity is found in the PM8250 properties panel.

    Input Channel Signal Level Meter – Displays the current input signal level and is scaled to 0 dBFS and OFF (-inf or MUTE). The meter is monitoring the signal level post A/D conversion, and is monitoring the RMS signal level.

    Input Channel Mute – Applies a full mute (no audio) to the selected input channel. When the input is in a mute state the input meter is still active as a reference.

Configuring Dante Endpoints
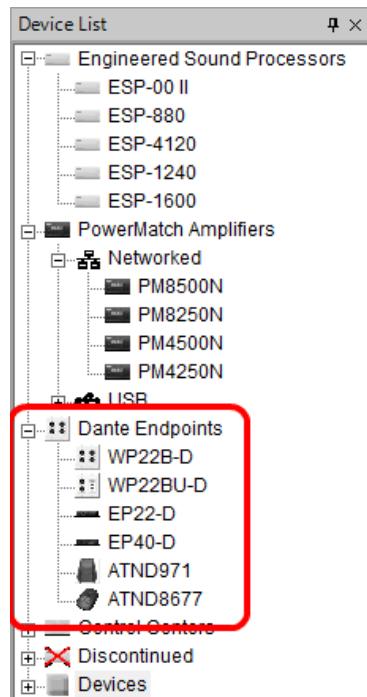
Device Icons and Controls for Dante Endpoints

Dante Endpoints can be found in the Device List in their own top level folder:

- WP22B-D 2-in/2-out Dante Wall Plate
- WP22BU-D 2-in/2-out Dante Wall Plate
- EP22-D 2-in/2-out Dante Endpoint
- EP40-D 4-input Dante Endpoint

- ATND971 Audio-Technica Cardiod Condenser Boundary Microphone with Dante Output
- ATND8677 Audio-Technica Microphone Desk Stand with Dante Network Output

As with other devices you can drag and drop these onto the project view to add them to a project.

Default Device List

Project View Icons and Controls

Endpoint devices have properties and a control panel that allows you to view and modify these properties. The Properties Window displays the list of properties and allows direct interaction for modifying their values.

The following figures show the Project View icon, the control panel, and the Properties Window for each device..

WP22B-D Off-line

WP22BU-D

	WP22BU-D	
	WP22BU-D 1	— X

Device

Identify   On-line ☐

Input 1	Input 2
Gain: 0 dB ▼	Source: A ▼
PWR	

Properties

WP22BU-D 1 (WP22BU-D)

□ Input	
Phantom Pwr. 1	False
Input Gain 1	0 dB
Input Source 2	A
□ WP22BU-D	
Label	WP22BU-D 1
Identify	False
Online	False

WP22BU-D Off-line

EP22-D

	EP22-D	
	EP22-D 1	— X

Device

Identify   On-line ☐

Input 1	Input 2
Gain: 0 dB ▼	Gain: 0 dB ▼
PWR	PWR

Output 1	Output 2
Gain: 0 dB ▼	Gain: 0 dB ▼
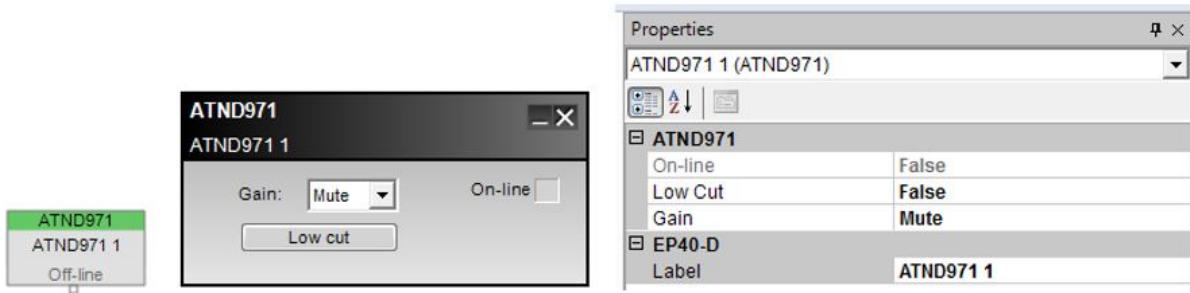
Properties   ⊣ ×

EP22-D 1 (EP22-D)   ▼

□ EP22-D	
Label	EP22-D 1
Identify	False
On-line	False
□ Input	
Phantom Pwr. 1	False
Input Gain 1	0 dB
Phantom Pwr. 2	False
Input Gain 2	0 dB
□ Output	
Output Gain 1	0 dB
Output Gain 2	0 dB

EP22-D Off-line

EP40-D

	EP40-D	
	EP40-D 1	— X

Device

Identify   On-line ☐

Input 1	Input 2
Gain: 0 dB ▼	Gain: 0 dB ▼
PWR	PWR

Input 3	Input 4
Gain: 0 dB ▼	Gain: 0 dB ▼
PWR	PWR
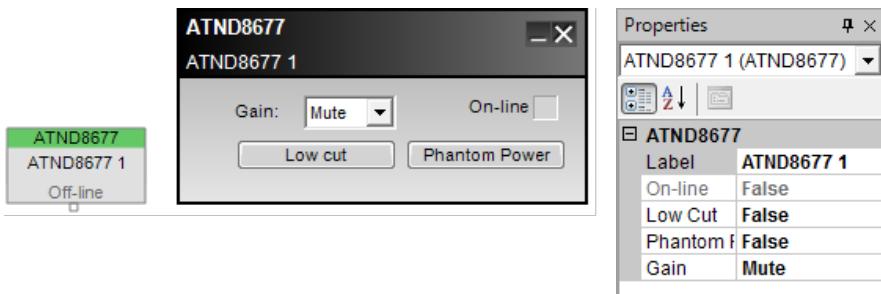
Properties   ⊣ ×

EP40-D 1 (EP40-D)   ▼

□ EP40-D	
Label	EP40-D 1
Identify	False
On-line	False
□ Input	
Phantom Pwr. 1	False
Input Gain 1	0 dB
Phantom Pwr. 2	False
Input Gain 2	0 dB
Phantom Pwr. 3	False
Input Gain 3	0 dB
Phantom Pwr. 4	False
Input Gain 4	0 dB

EP40-D Off-line

ATND971 Off-line
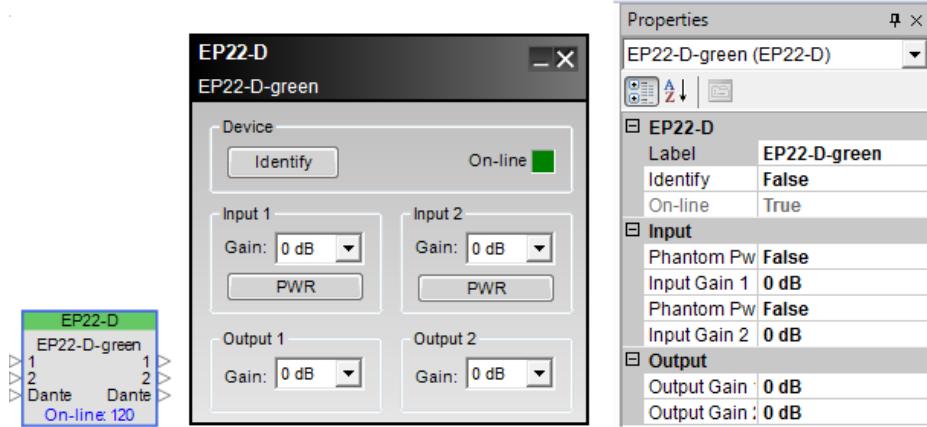
ATND8677 Off-line

On-line Status

After a Dante network scan, if the device is recognized on the network, the **On-line** control panel indicator will be green.

NOTE: The On-line control panel indicator will provide Network connection status and not ControlSpace® Designer™ software On-Line status.

EP22-D On-line

Identify button

Except for the ATND971, each device has a **Identify** button. Clicking this button triggers a flashing Power/ID indicator on the device, which continues until reset.

Gain selections

Input gain selections vary across the devices.

Input gain settings for WP22-D and WP22BU-D wall plates are 0 dB, +25 dB, and +40 dB. Input 2 on the WP22BU-D allows you to select A, A+B, or B.

Input gain settings for the EP22-D are 0 dB, +25 dB, and +40 dB. Output gain settings are 0 dB and +10 dB.

Input gain settings for the EP40-D are -12 dB, 0 dB, +3 dB, +15 dB, +18 dB, +30 dB, +33 dB, and +45 dB.

The ATND971 has gain settings of: Mute, +30 dB, +40 dB, +50 dB.
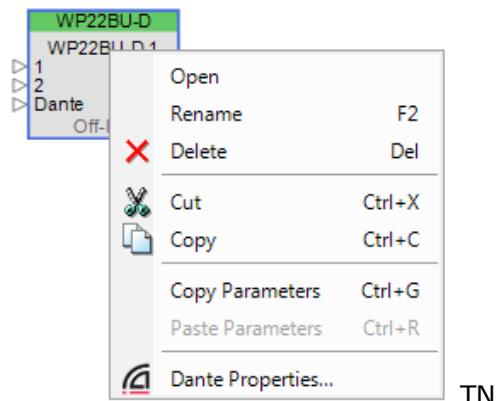
NOTE: The ATND971 does not retain any settings once disconnected from ControlSpace Designer software.Once disconnected, the mic gain is set to Mute (default).You can change mic settings only while it is online with ControlSpace Designer software.

Phantom Power Control

Phantom power can be switched on or off by clicking the **PWR** button.

Right-Click Menu

A mouse right-click on any endpoint icon opens the same context menu.

TN

Open displays the endpoint control panel.

Rename enables you to change the device name.

Delete removes the selected item from the Project View.

Cut deletes the selected item and copies it to the clipboard (standard Windows editing function).

Copy pastes a duplicate of the device to the clipboard (standard Windows editing function). All properties except name and state are copied. A unique name is assigned in keeping with the existing behavior for all other ControlSpace devices.

Copy Parameters copies the parameters, or settings, of the device. The parameters can be pasted to another device of the same type.

Paste Parameters pastes the copied settings from one or more devices of the same type.

Dante Properties launches the Dante properties Window.
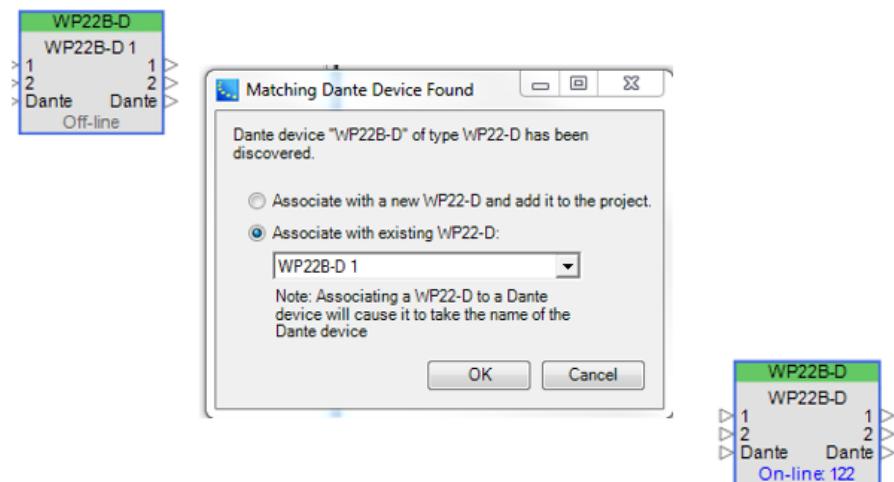
After a device in a ControlSpace Designer project has been associated with a device on a Dante network, the option of **Break Association to Dante device** is added to the right-click menu. After selecting this option it will read **Associate with Dante Device**

Working With Endpoint Associations
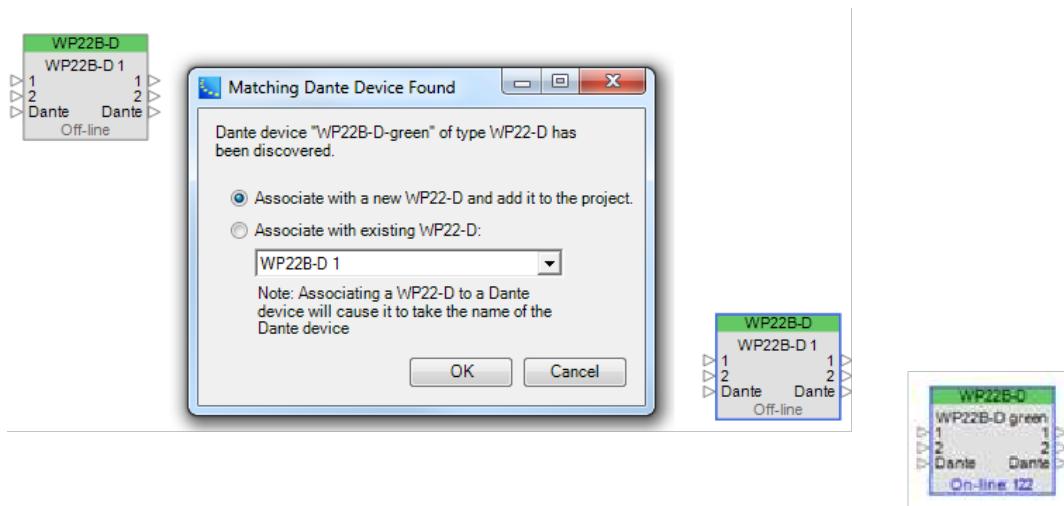
To use a Dante endpoint, the device block in ControlSpace Designer software must be associated with the hardware device that is on the Dante network. These associations are managed by a segment of the software called the Network Manager.

Endpoint Associations with Device Drag & Drop

When an endpoint is dragged and dropped into the Project View, the Network Manager is notified. A search is begun for a device with the same name as the device block in Project View. If found, the association is made. If not, you will be presented with the following dialog box. Using this dialog box you can choose to associate with the existing hardware device shown in the drop-down list, or with a new hardware device that will be added to the project with default properties. When associating with an existing device, the Project View device is renamed to match the existing device.

Associating with an existing hardware device

Associating with a new hardware device
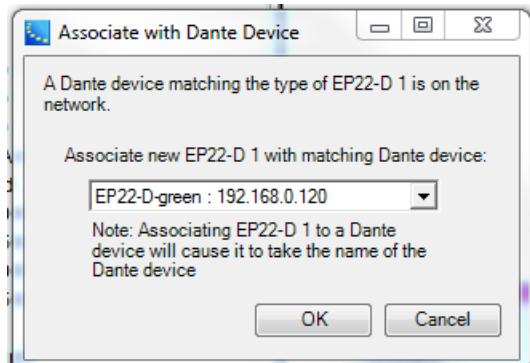
Endpoint Associations after Delete or New Project

When an endpoint has already been scanned into Project View, all endpoint associations are made, and Dante information is being displayed for each, deleting a module from Project View and/or selecting New in the File menu, there is no rescan of endpoints to make modules reappear in Project View as is done with other devices (ESP processors or PowerMatch amplifiers).

To re-associate an endpoint into the design and match to each one listed in Dante Properties, you will need to drag/drop each one back into Project View. Upon dragging an endpoint back into Project View (and Dante Properties is present for the endpoint), you will be presented with the following dialog box.

Selecting **OK** associates the Project View device to the connected endpoint device that has Dante Properties associated with it as well.

If you choose to **Cancel** or close the dialog, no association will be made to the device dragged into Project View.
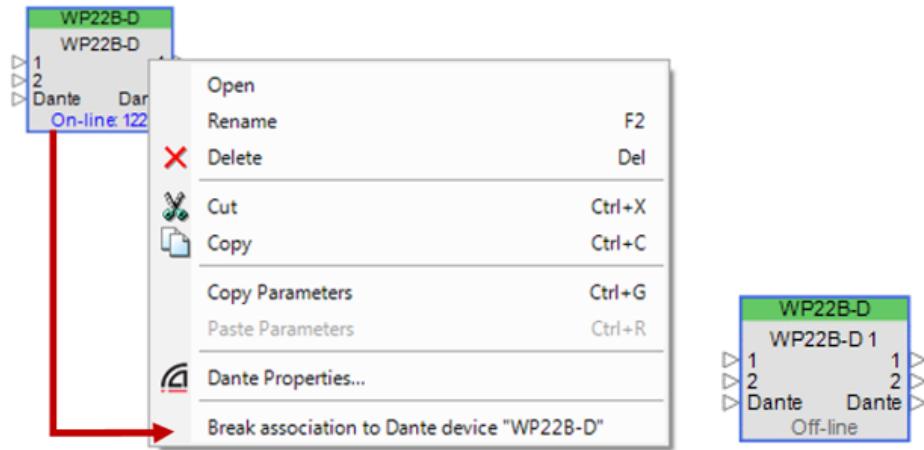
Associating with a matching Dante Device

Manually Setting or Breaking Endpoint Associations
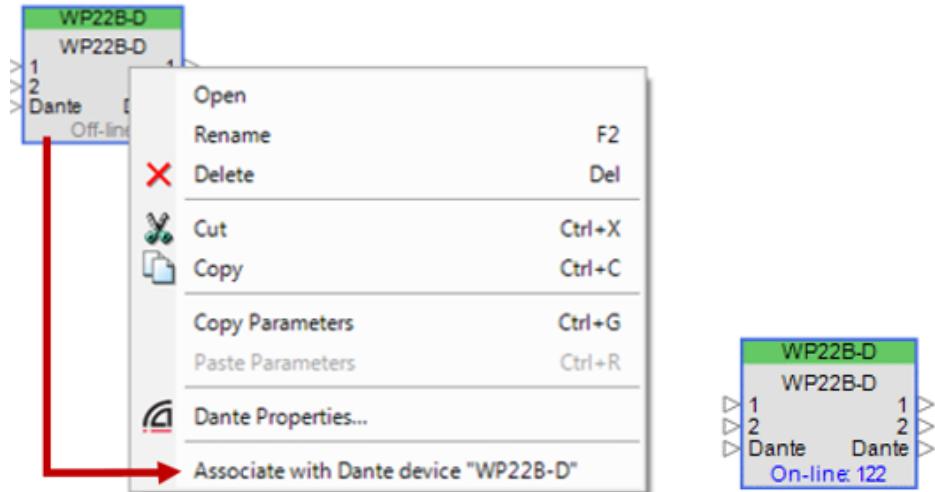
Breaking an association

If an association is made to the endpoint device displayed in Project View (seen as On-line), you can break the association to the device if needed. In the right-click menu, select **Break association to Dante device**. This will break the association of the Project View endpoint device to a connected matching device and display it as Off-line.

Associating to a device

If an association to the endpoint has been broken or not made, and the endpoint is listed in Dante Properties, you can make the association again. Right-click on the device in Project View and select **Associate with Dante device**.

Name changes
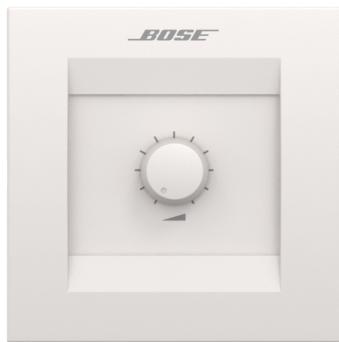
If you change the name of a previously unassociated Project View endpoint,and if the name matches an unassociated Dante hardware device of matching type, an association is automatically made.

If you change the name of an associated Project View endpoint, the name of the associated Dante hardware device is changed to match. The same action happens if you change the name of an associated Dante endpoint via Dante Properties.
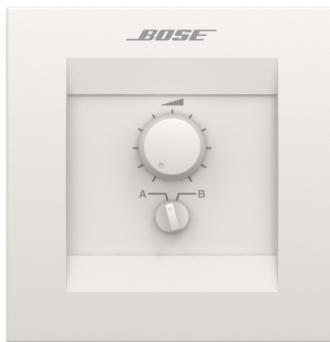
Configuring Control Centers

Volume Controls

The Bose Volume Control, Volume Control with A/B switch , and CC-4 Room Controller interfaces are engineered to provide custom on-site volume controls for engineered sound processors. They are all designed to connect via GPI ports.
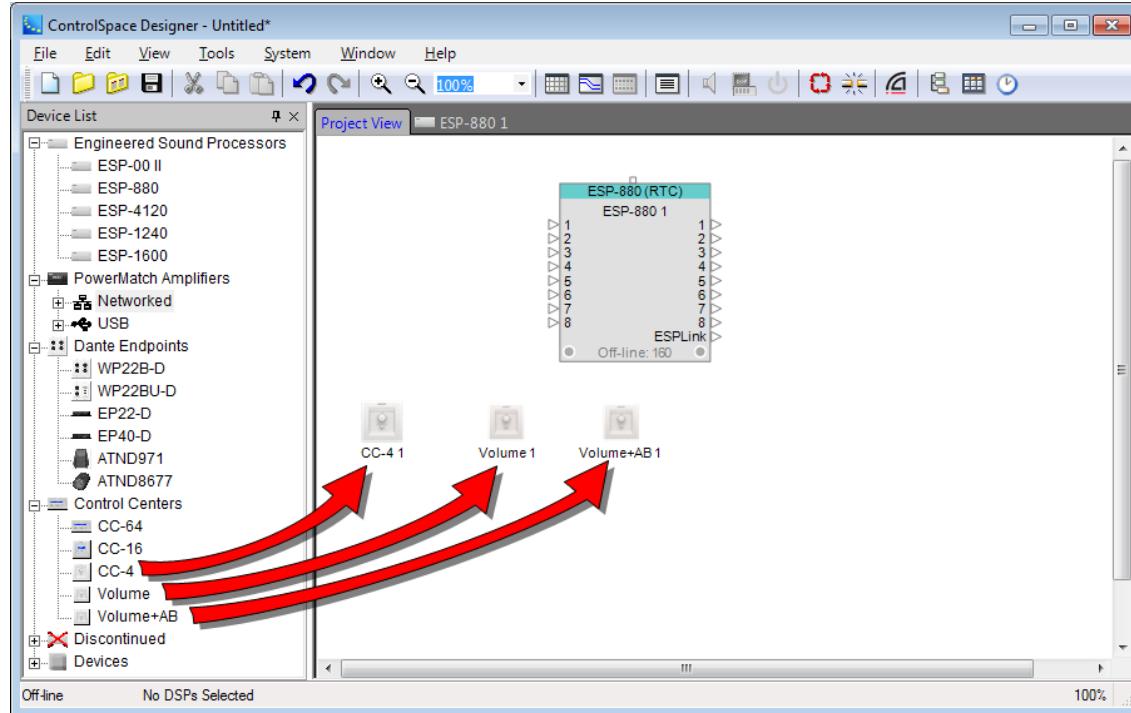
Volume Control   *Volume Control with A/B Switch*   *CC-4 Room Controller*

These controls have no dedicated control panels within the Signal Processing View. They have Project View icons only.

Each of these controls have individual characteristics and programming requirements as shown in the following table.

Control Type	Fully CW	Fully CCW	GPI Mode
Volume	0 Ohms	10K Ohms	A–
Volume A+B	0 Ohms	10K Ohm	A– for Volume, D for switch selections
CC-4	10K Ohm	0 Ohms	A+ for Volume, D for switch selections

For details on connection to GPI ports, see Programming GPIO.
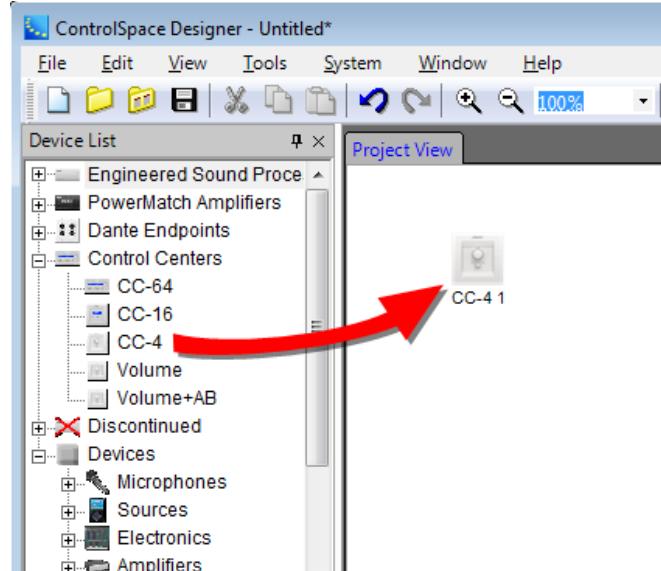
For details on programming GPI ports, see Programming GPI.

For programming information, see Programming Volume Controls.

CC-4 Room Controller

The **CC-4 Room Controller** is a wall-mounted control panel. It includes one rotary volume control and a four posi- tion selector switch. Both the volume control and selector switch are designed to connect to GPI ports. See Pro- gramming Volume Controls for details on associating signal processing features to a CC-4 via GPI ports.

A Project View icon is provided for project documentation purposes.

CC-4 Project View Icon

CC-4 Room Controller
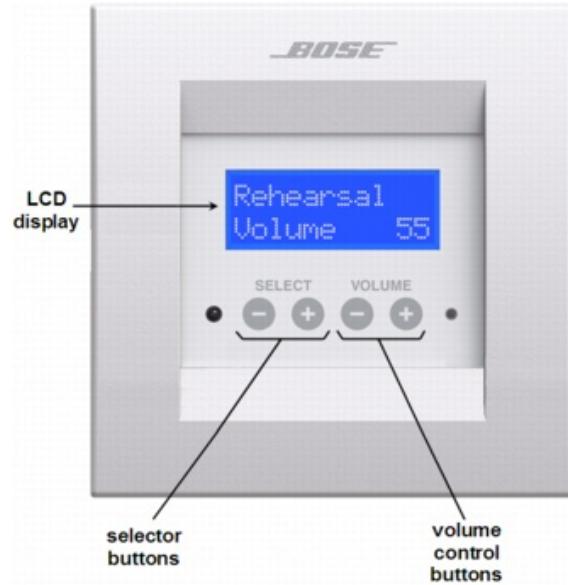
The CC-4 Room Controller supports the following programming features:

Volume Control – Analog Control Input modes of individual GPI ports.

Selector Switch – Digital Control Input and Digital Up/Down modes of individual GPI ports.

CC-16 Zone Controller
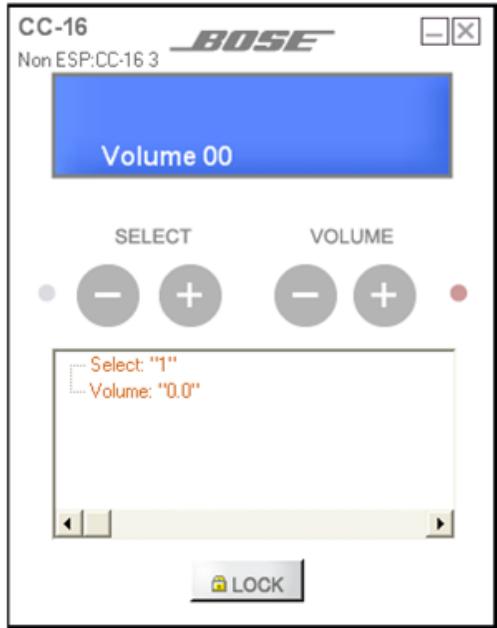
The **CC-16 Zone Controller** is a wall-mounted control panel. The CC-16 includes a membrane touch panel with two selector buttons and two volume control buttons. It also has a two-line, 12 characters per line backlit LCD display. The selector and volume control buttons are fully programmable. See Programming CC-16 Zone Controllers.

CC-16 ZoneController

CC-16 Smart Simulator

The CC-16 Smart Simulator is a software-based tool within ControlSpace Designer used for programming and simulated operation of the CC-16 Zone Controller. To open the CC-16 Smart Simulator, double-click on the CC-16 block in *Project View* or right click and select **Open**.

CC-16 Smart Simulator

The **CC-16 Smart Simulator** provides the following options:

Virtual LCD – Represents the two-line backlit display on the CC-16 zone controller.

Select – Provides minus and plus click zones to simulate selector button presses on the CC-16 zone controller.

Volume – Provides minus and plus click zones to simulate volume button presses on the CC-16 zone controller.

Programming Tree – Provides a landing zone for signal processing and other programmable elements. Assign functions to the Select buttons, or to the Volume control buttons by dragging and dropping onto the programming tree. See Programming Control Centers/CC-16 for details on associating signal processing features to a CC-16.

Lock – displays the current lock state and provides a programming toggle button for adjusting the control panel lock. Locked panels are identified by the word "--Locked--" beside a green lock button. Locked status must be enabled or disabled from a parameter set.
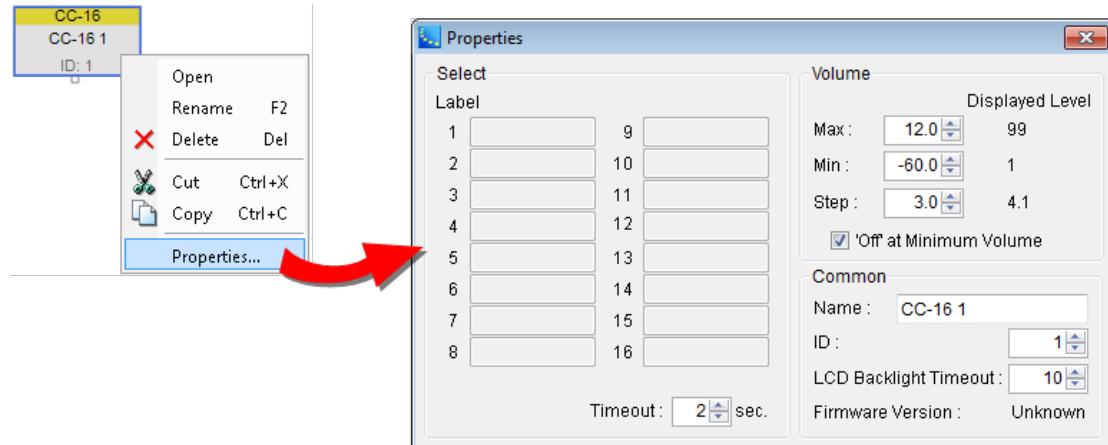
CC-16 Locked and Unlocked Button States

Note: When an ESP system is online and a control panel lock is enabled, software simulators respond to button clicks but matching hardware in the field no longer accepts input.

CC-16 Zone Controller Properties

To view or adjust CC-16 properties, right click on the device in Project View, and choose Properties.

CC-16 Properties

Properties available for the CC-16 are as follows:

> **Select** – provides configuration options for the minus and plus touchpad selector buttons.
>
>> **Label** – is a series of text fields which reflect the name of a selector position within the CC-16 display. Sixteen label fields are available. These labels are populated automatically by the associated signal processing block selector position name or parameter set name when the panel is programmed. After programming is complete this label may be adjusted to a different value to match project needs.
>>
>> **Timeout** – is an adjustable time value from 0 to 10 seconds for configuring the *Selection Preview* feature of the CC-16. Selection Preview adds delay to permit viewing the name of the next selector position in either minus or plus directions before performing the programmed action. Returning to the initial selection before this time expires results in no system change.
>>
>> A value of 0 seconds switches to the next selector position and initiates the programmed action immediately. Values from 1 to 10 seconds add this amount of delay for varying lengths of Selection Preview time.
>
> **Volume** – provides configuration options for the minus and plus volume touchpad volume buttons.
>
>> **Max:** – configures the maximum volume level permitted by an associated signal processing block when pressing the plus button on the CC-16. This value ranges from a maximum of 12dB down to the configured **Min** setting plus one **Step** setting value.
>>
>> This **Max** value equates to a Displayed Level of 99 on the CC-16.
>>
>> **Min:** – configures the minimum volume level permitted by an associated signal processing block when pressing the minus button on the CC-16. This value ranges from a minimum of -60dB up to the configured **Max** setting less one **Step** setting value.
>>
>> This **Min** value equates to a Displayed Level of 1 on the CC-16.
>>
>> **Step:** – configures the amount of change to an associated signal processing block when pressing either the minus or plus buttons on the CC-16. This value ranges from 0.5dB to 36.5dB and defines the **Max** and **Min** levels permitted.
>>
>> **Displayed Level** – is a calculated value based on current Max, Min, and Step settings to reflect the number shown on the CC-16 display.

'Off' at Minimum Value - When enabled, the CC-16 will display "OFF" on the display when it reaches the minimum volume level. When disabled the display will read "--".

Common – provides configuration options for the global characteristics of the control panel.

> **Name:** – defines the name displayed on the CC-16 block within Project View. This field automatically updates to the current name if the CC-16 is renamed within Project View.
>
> **ID:** – is a unique identification number assigned to each CC-16. Values range from 1 to 15. The default value is 1.
>
> **Note:** Each time a new CC-16 is added to project view; this ID value must be adjusted to a unique number if more than one CC-16 exists within your system design. It must also match the DIP Switch settings of the associated CC-16 in the field for programming to operate correctly.
>
> **LCD Backlight Timeout:** – establishes the amount of time in seconds that a CC-16 display remains illuminated after the most recent button press. Values range from 0 to 30 seconds with a default of 10 seconds. A value of 0 seconds forces the display to remain illuminated continuously.
>
> **Firmware Version:** – displays the current version of firmware available within each system to manage CC-16 operations. Before the first connection to existing hardware, this value is listed as *Unknown*. After the first connection in a ControlSpace Designer program session, this field is automatically updated to reflect current firmware version.

CC-16 Zone Controller – Monitor Mode

When ControlSpace Designer is started in Monitor Mode, the CC-16 Smart Simulator appearance is altered to show only user adjustable click zones and *Lock* status. In this mode, the programming tree is no longer visible to prevent user tampering with programmed objects. See Monitor Mode for details.
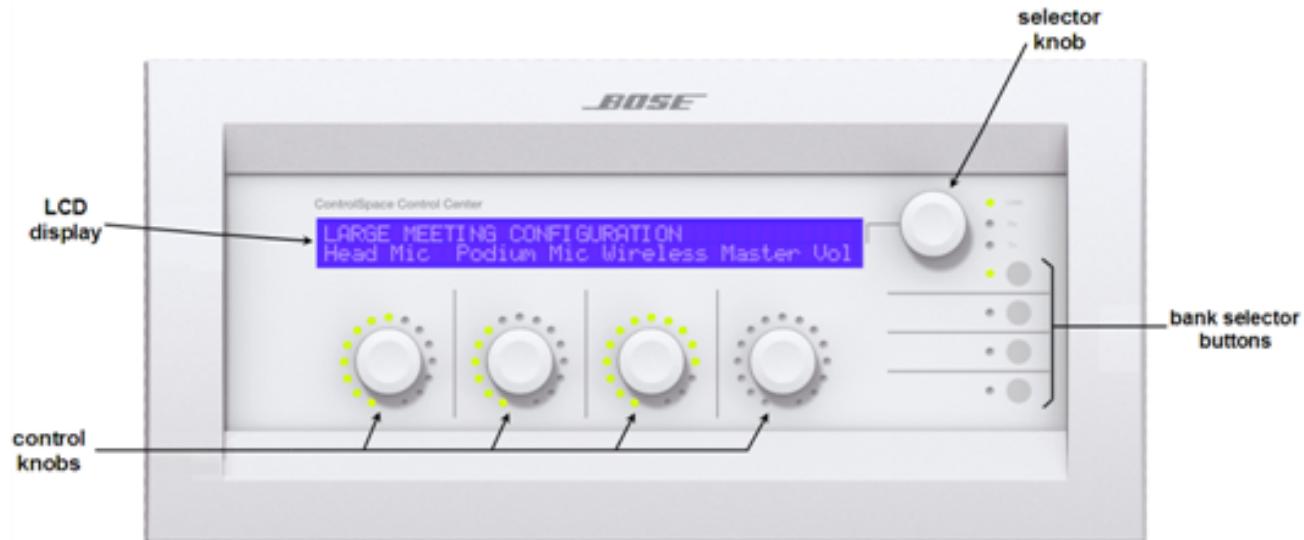
CC-16 in Monitor Mode

CC-64 Control Center

The **CC-64 Control Center** is a wall-mounted control panel. The CC-64 includes a master selector knob, four individual gain/selector knobs, four membrane bank select buttons, and a two-line 40 characters per line backlit LCD display. The master selector knob, gain/selector knobs, and display are fully programmable. See Programming CC-64 Control Centers.

The master selector has three LEDs indicating network link status, network data receive, and network data transmit. Each gain/selector knob is surrounded by 15 LEDs which indicate the relative position of the knob. Each bank select button has an LED to indicate when it's active. And the bottom line of the LCD display serves as labels for the gain/selector knobs.
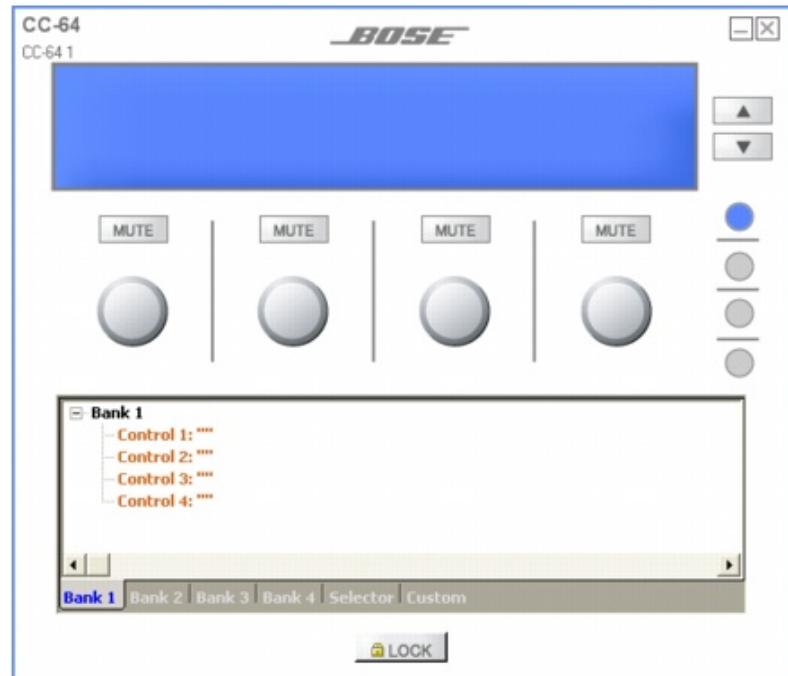
The four gain/selector knobs may control different signal processing functions in each of the four banks, for a total of sixteen settings. Use the bank select buttons to assign control of the gain/selector knobs to one of the four banks at a time.

CC-64 Control Center

CC-64 Smart Simulator

The CC-64 Smart Simulator is a software-based tool within ControlSpace Designer used for programming and simulated operation of the CC-64 Control Center. To open the CC-64 Smart Simulator, double-click on the CC-64 block in **Project View** or right click and select **Open**.

CC-64 Smart Simulator

The **CC-64 Smart Simulator** provides the following options:

Virtual LCD – Represents the two-line backlit display on the CC-64 control center.

Selector Up/Down – Provides click zones to simulate the master selector knob rotation on the CC-64 control center.

Mute buttons – Provide click zones to simulate the push to mute functionality of the gain/selector knobs on the CC-64 control center.

Virtual gain/selector knobs – Provide click & rotate zones to simulate gain/selector knob rotation on the CC-64 control center.

Virtual bank buttons – Simulate bank selection of the CC-64 control center.

Programming Tree – Provides a landing zone for signal processing and other programmable elements. Assign functions to the master selector, gain/selector knobs, or to bank select buttons by dragging and dropping onto the programming tree. See Programming Control Centers/CC-64 for details on associating signal processing features to a CC-64.

Lock – displays the current lock state and provides a programming toggle button for adjusting the control panel lock. Locked panels are identified by the word "--Locked--" beside a green lock button. Locked status must be enabled or disabled from a parameter set.
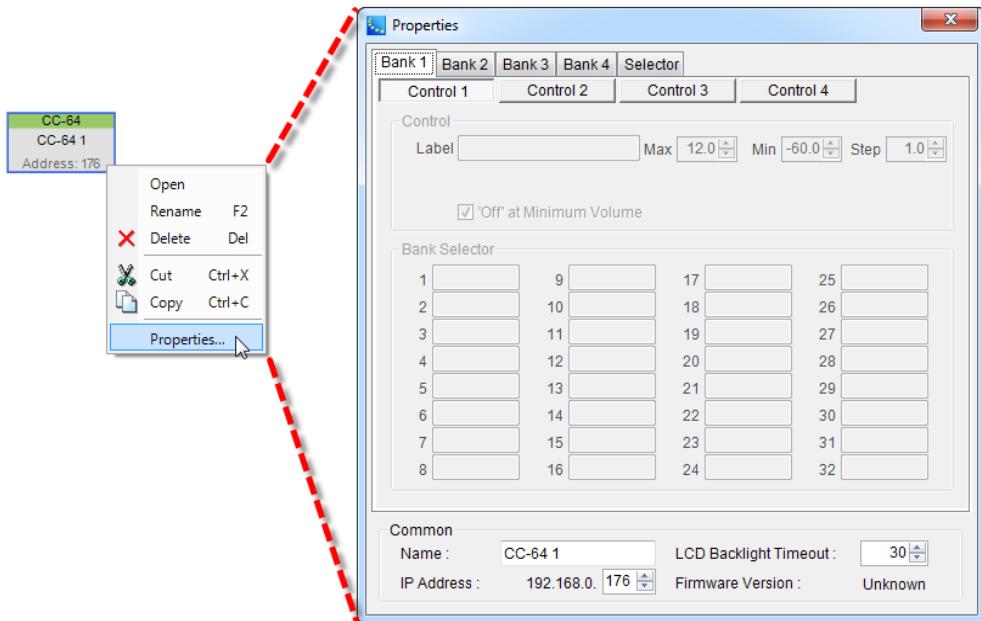
CC-64 Locked and Unlocked Button States

Note: When an ESP system is online and a control panel lock is enabled, software simulators respond to button clicks but matching hardware in the field no longer accepts input.

CC-64 Control Center Properties

To view or adjust CC-64 properties, right click on the device in Project View, and choose Properties.

CC-64 Properties

Properties available for the CC-64 are as follows:

Bank/Selector Tabs – display options for the bank and master selector configuration pages of the CC-64. Click a tab to view options for each configuration page.

Control Buttons – correspond to individual settings available for each gain/selector knob.

Control – sections display unique options for each gain/selector knob on the CC-64 from 1 to 4.

> **Max:** – configures the maximum volume level permitted by an associated signal processing block when rotating the gain/selector knobs clockwise on the CC-64. This value ranges from a maximum of 12dB down to the configured **Min** setting plus one **Step** setting value.

> **Min:** – configures the minimum volume level permitted by an associated signal processing block when rotating the gain/selector knobs counterclockwise on the CC-64. This value ranges from a minimum of -60dB up to the configured **Max** setting less one **Step** setting value.

> **Note:** When the gain/selector knobs are fully rotated in either direction, levels shown on the CC-64 LCD display match the value stored in the Max / Min fields.

> **Step:** – configures the amount of change to an associated signal processing block when rotating a gain/selector knob on the CC-64. This value ranges from 0.5dB to 36.5dB and defines the **Max** and **Min** levels permitted.

> **Label** – is a text field to customize the name of a gain/selector knob within the CC-64 display. This text appears on the second line of the LCD display directly above each knob and is automatically populated by the associated signal processing block selector position name or parameter set name when the panel is programmed. After programming is complete, this label may be adjusted to a different value to match project needs.

> The first 9 characters of this label are displayed by default. Each time a bank is selected; labels for its four gain/selector knobs are displayed for one second. Any additional characters in the label are then scrolled horizontally in the display from right to left then left to right to permit viewing the complete label.

'Off' at Minimum Value - When enabled, the CC-64 will display "OFF" on the display when it reaches the minimum volume level. When disabled, the display will read "--".

Common – provides configuration options for the global characteristics of the control panel.

Name: – defines the name displayed on the CC-64 block within Project View. This field automatically updates to the current name if the CC-64 is renamed within Project View.

IP Address: – is a unique network identification number assigned to each CC-64. Values may be any address within the same subnet of the system under control that is not already in use. The default value is 192.168.0.160.

Note: CC-64 control centers should be physically connected to the network one at a time and programmed with unique IP Addresses to avoid conflicts with other devices on the network configured with the default address.

LCD Backlight Timeout: – establishes the amount of time in seconds that a CC-64 display remains illuminated after the most recent button press. Values range from 0 to 30 seconds with a default of 30 seconds. A value of 0 seconds forces the display to remain illuminated continuously.

Firmware Version: – displays the current version of firmware available within each system to manage CC-64 operations. Before the first connection to existing hardware, this value is listed as *Unknown*. After the first connection in a ControlSpace Designer program session, this field is automatically updated to reflect current firmware version.

CC-64 Control Center – Monitor Mode

When ControlSpace Designer is started in Monitor Mode, the CC-64 Smart Simulator appearance is altered to show only user adjustable click zones and *Lock* status. In this mode, the programming tree is no longer visible to prevent user tampering with programmed objects. See Monitor Mode for details.

CC-64 in Monitor Mode

Controlling System Devices

Programming Overview

ControlSpace Designer software allows you to create associations between signal processing and control center operations to meet the unique requirements of any project. These various associations are stored within ControlSpace System Project files (.csp) on the programming computer and within ControlSpace hardware devices for recall on demand both manually and automatically.

The process of defining relationships between processing and control options into a single integrated project file is called programming the system. The primary work area within the ControlSpace Designer user interface where control options of system programming are stored is called the *Control Library*.

To get started, see:

Work Space

Parameter Sets

Programming Dante Subscriptions into Parameter Sets

Groups

Timers

Programming with composite device blocks
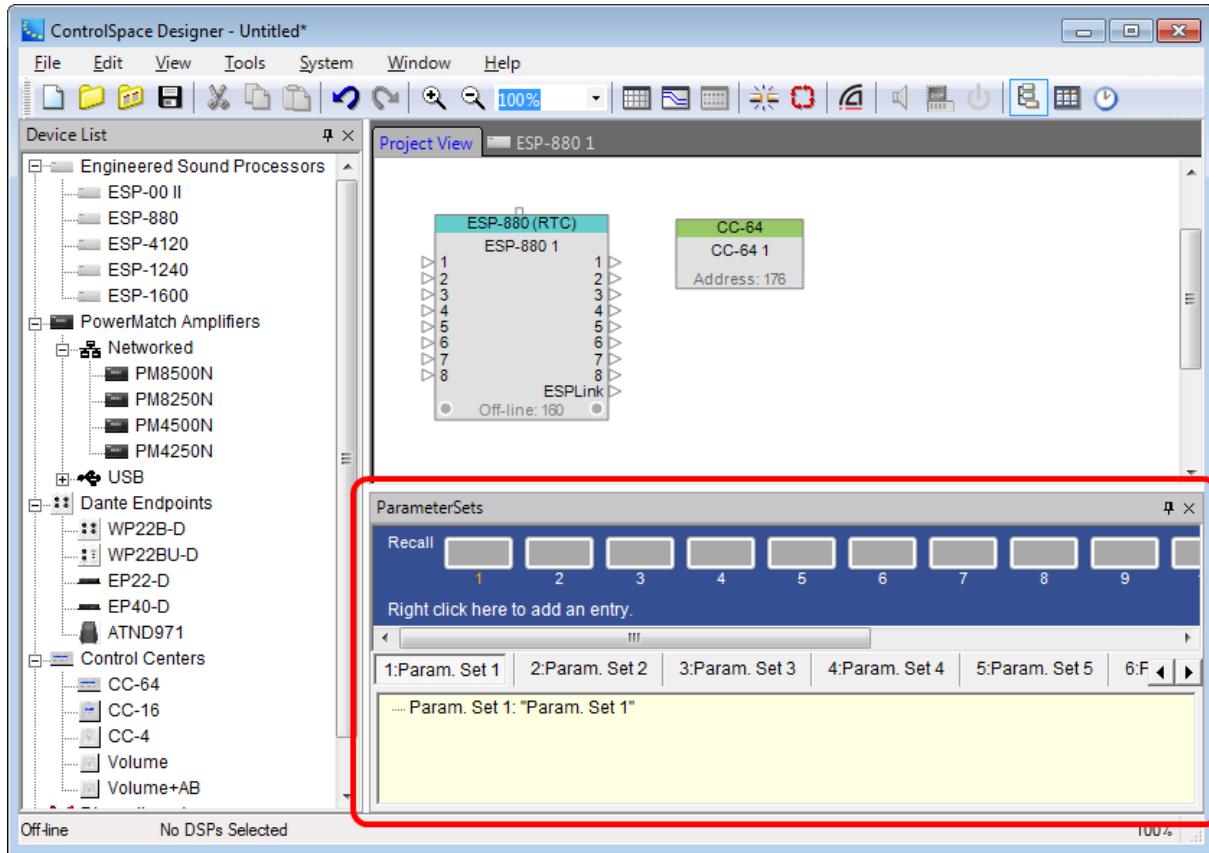
Control Library

Work Space

This primary work area is the "drop zone" for drag and drop control programming functions.

Three control library function types are available for use in this work area:

- Parameter Sets
- Groups
- Timers

Control Library Workspace
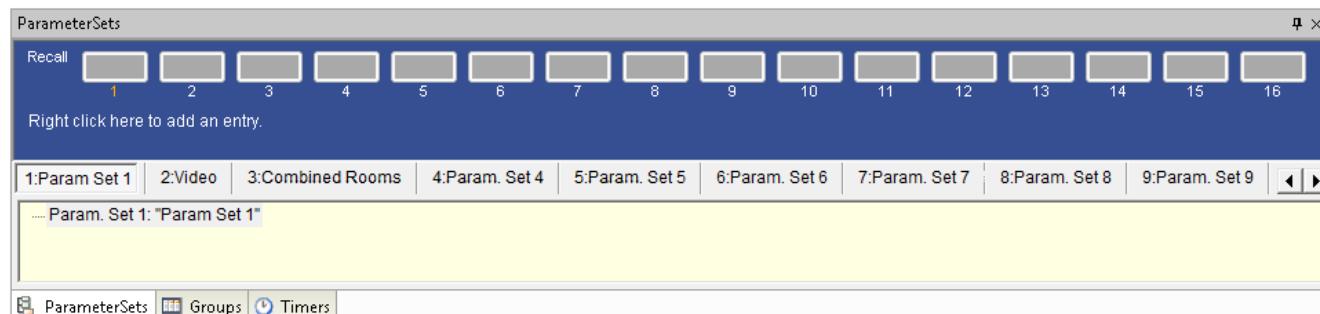
Parameter Sets

A parameter set stores a snapshot of selected signal processor settings which can later be recalled manually using an external trigger, such as a GPI or control center, or invoked by a timed event. Use parameter sets when you want to change the state of specific processing parameters without affecting the state of the entire design.

Access parameter sets by enabling the parameter sets window from the main menu; Window > Parameter Sets.

Creating a Parameter Set

Open the Parameter Sets window by accessing the Window Menu and selecting Parameter Sets from the list of available windows.
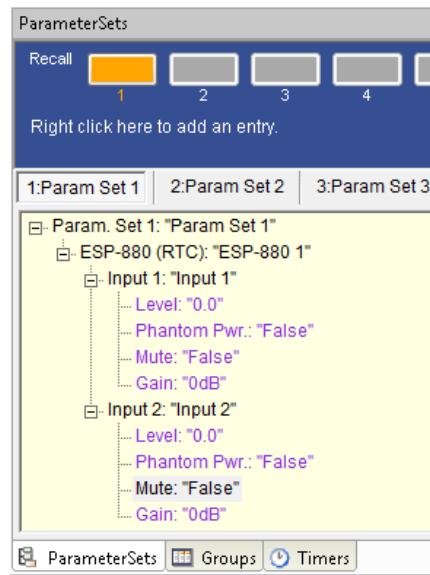
Parameter Sets window

To program a parameter set:
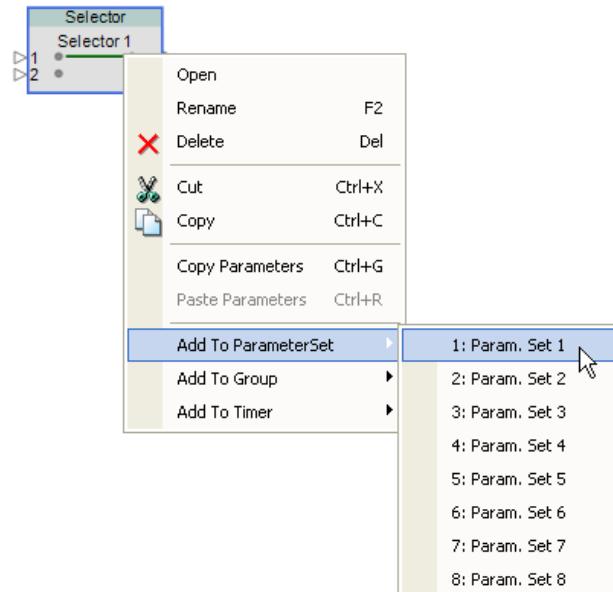
1. Define the state of the signal processing functions to be included.

2. Drag the desired processing blocks into the parameter set tree in the Parameter Set window.

3. Rename the parameter set using the right-click menu or F2 key.

4. Test the parameter set

Tip: Double-click on a name in the tree structure to open the control panel for that device or block.

Parameter set tree structure

Another way to add blocks to a parameter set is to select one or more blocks, right click, and choose Add To Parameter Set.
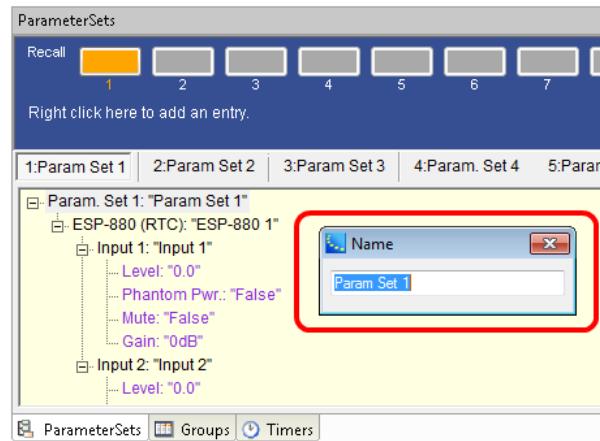
Right click to add to a parameter set

Note: To change the value of a setting in the parameter set, first change the setting in the block control panel and then drag and drop it into the parameter set once more. You do not need to delete the block from the parameter set to update its settings.

Renaming a Parameter Set

To rename the parameter set, select the top level of the tree structure and press F2, or right click and choose Rename.

Rename the parameter set

Editing Parameter Sets

The values of parameters are displayed but cannot be changed within the Parameter Sets window. If you need to change the value of a specific setting that is part of a parameter set (for example, a gain of -6 dB), you will need to change the setting of the signal processing block's control panel, and then drag and drop the block once more into the parameter set.
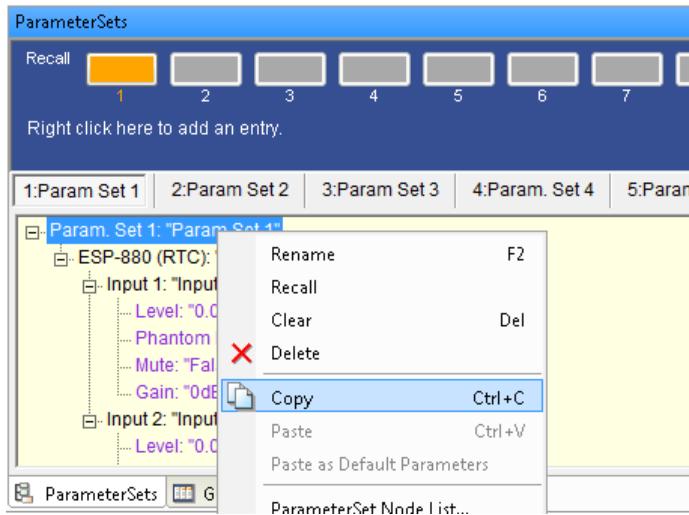
Copy/Paste Parameter Sets

Parameter sets can be copied and pasted. Right-click on a parameter set within the Parameter Sets window to access the copy/paste functions.

Select a Parameter Set within the Control Library or Project Directory by right-clicking on it, and selecting Copy from the context menu. You can now paste the signal processing blocks in this Parameter Set to a second Parameter Set using one of two options:

Paste – Places an exact copy of the Parameter Set and its settings.

Paste Default – Copies the modules associated with the Parameter Set, but restores them to their default values. For example, if a parameter set has a gain module with the level set to -6 dB and Mute is true, the Paste as Default Parameters will paste the gain module but reset the level and mute to their default values, i.e., 0 dB and unmuted.
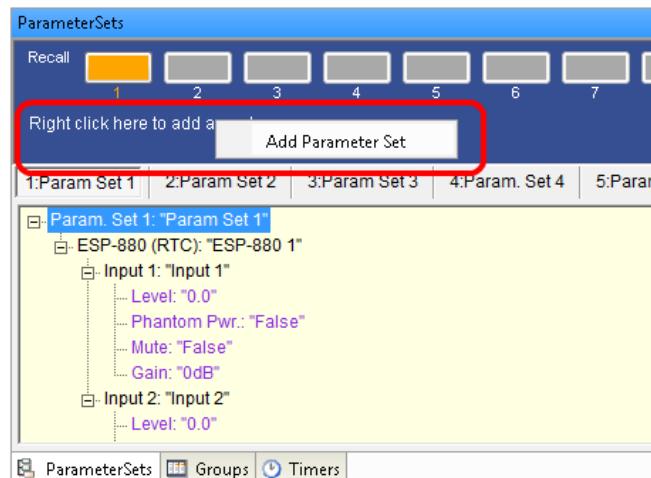
Parameter Set Copy

Note: When pasting a Parameter Set, any existing Parameter Set data is overwritten.

Adding additional Parameter Sets

The default quantity of parameter sets is 16, but additional parameter sets may be added.

To add more parameter sets, right-click anywhere in the blue area where the **Right click here to add an entry** text is displayed. Then click the **Add Parameter Set** pop-up option to add a new parameter set at the end of the list.
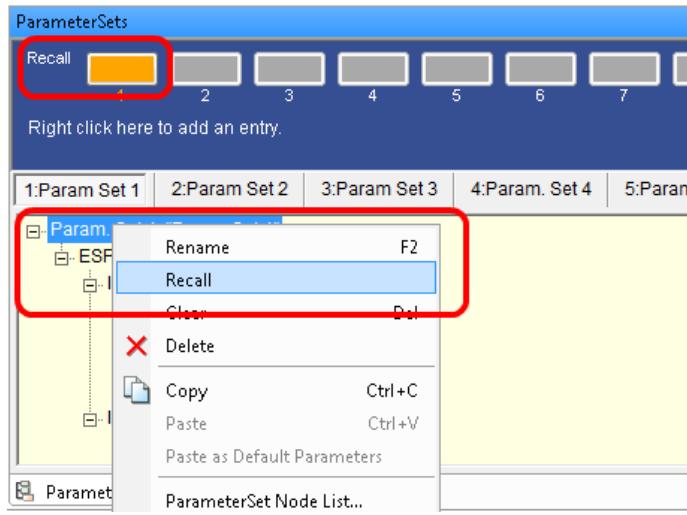
Adding a Parameter Set

Recalling parameter sets

Active parameter sets are indicated by the color orange for the Recall button.

To test parameter set programming, parameter sets may be recalled or invoked while off line. First, open included signal processing objects, and then recall the parameter set by selecting its number in the parameter set window.

Recalling a Parameter Set

You can view the change in settings from within the control panel.
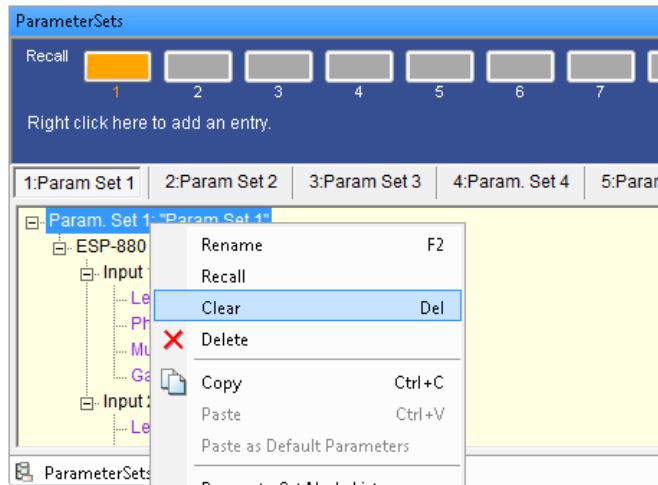
Pressing the Recall button recalls the state of all signal processing blocks within the parameter set to the stored values.

NOTE: Right clicking on a parameter set name provides an alternate method of recalling a parameter set.

Clearing parameter sets

To clear the programming of a Parameter Set, right-click on the top level of the Parameter Set's tree structure, and select **Clear**. This removes the programming but leaves the Parameter Set to be used again. You can also click the orange button to clear the programming.
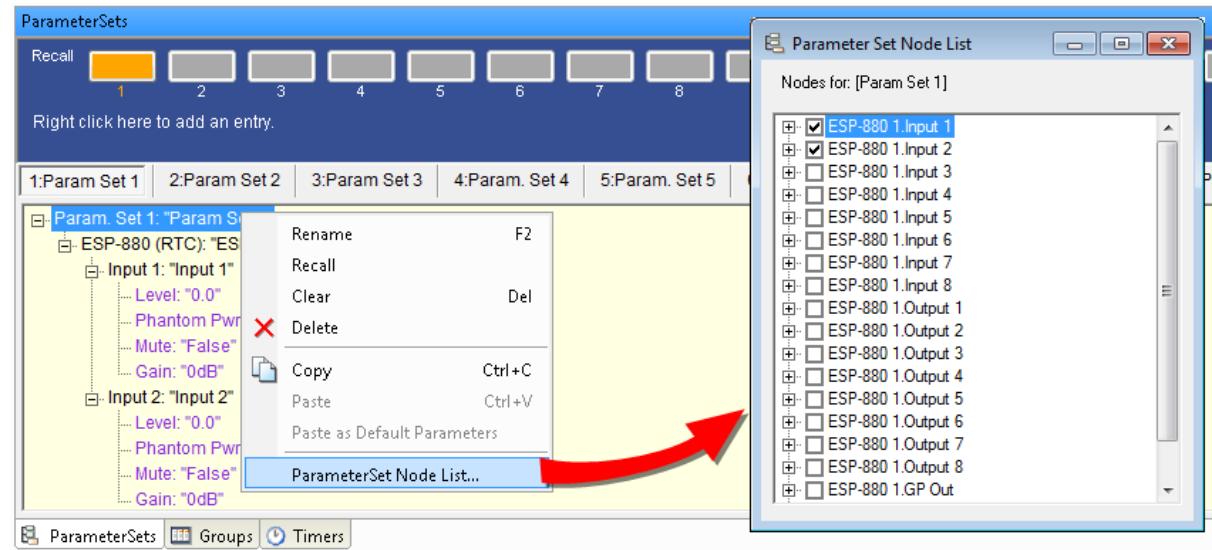
NOTE: Selecting Delete removes the Parameter Set and its programming.

Clear a Parameter Set
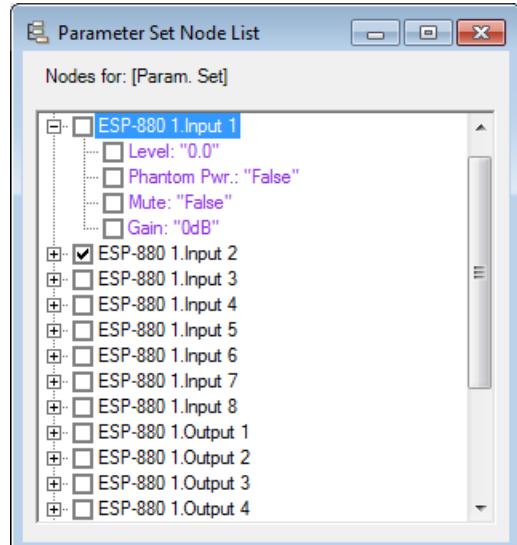
Parameter Set Nodes List

Parameter Sets may also be created or modified using the Parameter Set Nodes List. To access the Parameter Sets Nodes list, double-click on the parameter set name in the Parameter Sets window. The Parameter Set Nodes List may also be accessed using the right-click option. Once enabled, the Parameter Set Nodes List window shows all signal processing nodes in your system, and indicates those assigned to the parameter set.
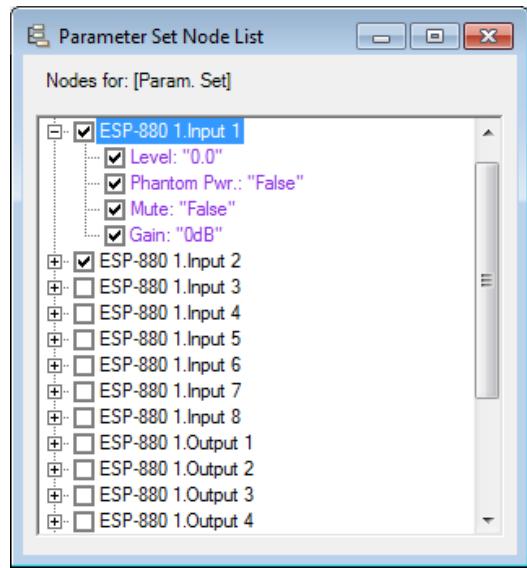
Opening the Parameter Set Nodes List

From within the Parameter Sets Nodes List it is possible to determine exactly which processing objects from all system devices are included in the parameter set. The list also displays which specific controls for the signal processing functions are included.

Expand a device to see properties
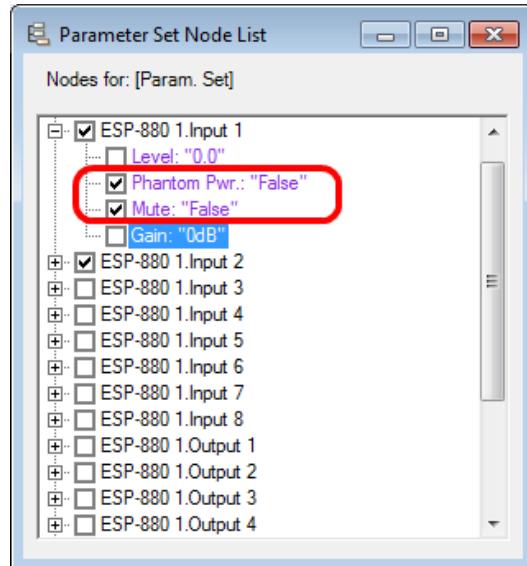
When creating new parameter sets, you may specify exactly which settings you want to store. To store all settings for a given block, place a check mark next to the block name, as shown in the following figure. Note that all the settings within the block are automatically selected.

Include all settings for the device

Storing Discrete Parameters

To include only specific settings in the parameter set, use the Parameter Set Nodes List and place a check mark next to the settings within the block, as shown in the following figure. When the parameter set is invoked, only the selected settings are changed, reducing the possibility of accidentally changing key system settings. The settings that are not checked are not part of the parameter set and remain unchanged when the parameter set is invoked.

Include selected settings in the parameter set

You can also use the Parameter Set Nodes List to modify an existing parameter set. Open the Parameter Set Nodes List and check or uncheck the settings that you want to include in the parameter set.

Programming Dante Subscriptions into Parameter Sets
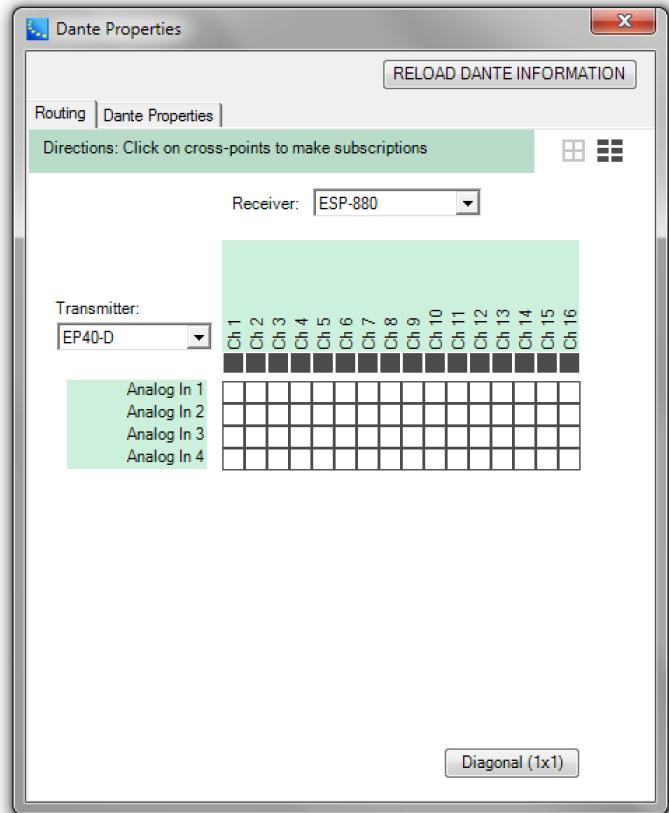
Both ControlSpace® ESP processors and PowerMatch® amplifiers when used with Dante™ network cards have the capability to allow Dante input subscriptions to be programmed for later recall. This functionality is especially useful for systems that have many Dante audio channels available. Re-callable subscriptions allow only the desired Dante channels to be received, reducing the need for manual reprogramming or idle input channels, thus saving overall system costs.

Re-callable Dante subscriptions are set using parameters sets. Once programmed, parameter sets can be triggered by external events such as user controls or timers.

NOTE: While most Parameter Sets can be programmed "off-line", moving Dante subscriptions into Parameter Sets must be done "on-line" with applicable Dante devices active on the network.
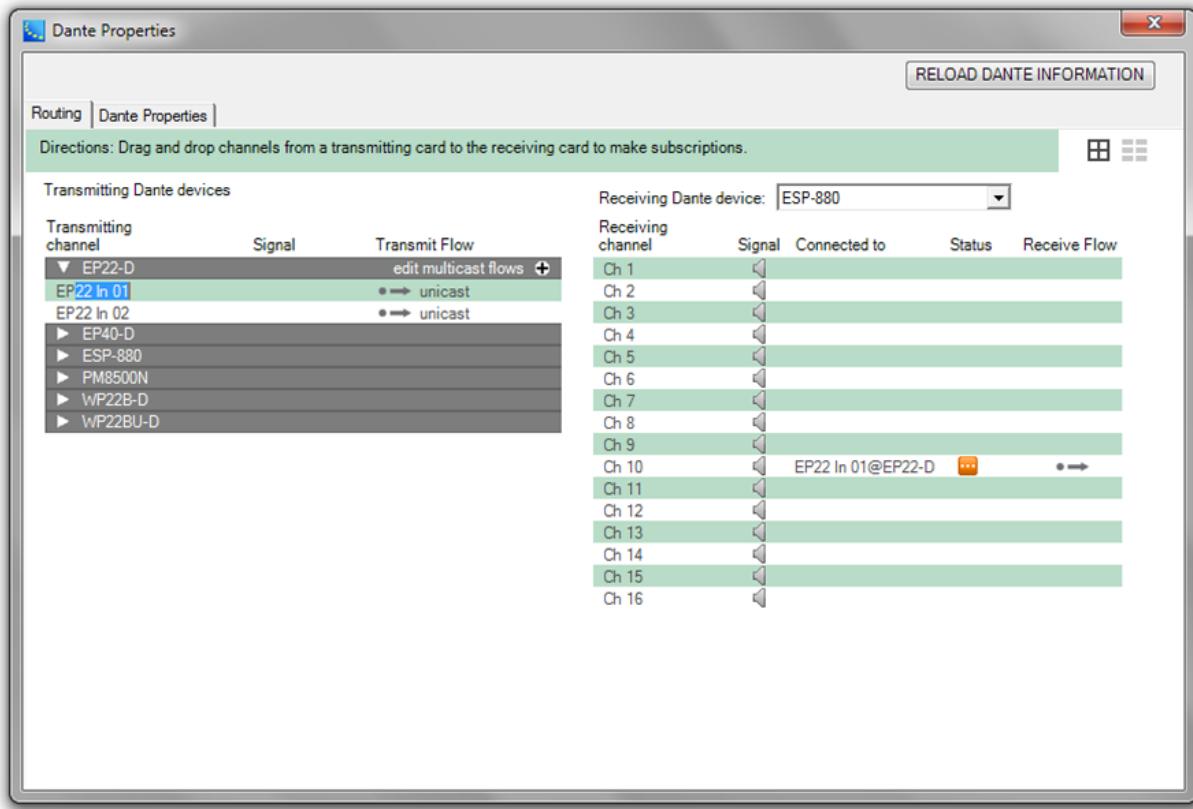
To program a Dante subscription into a parameter set:

1. Open the Routing tab in the Dante properties control panel

Dante Properties Window
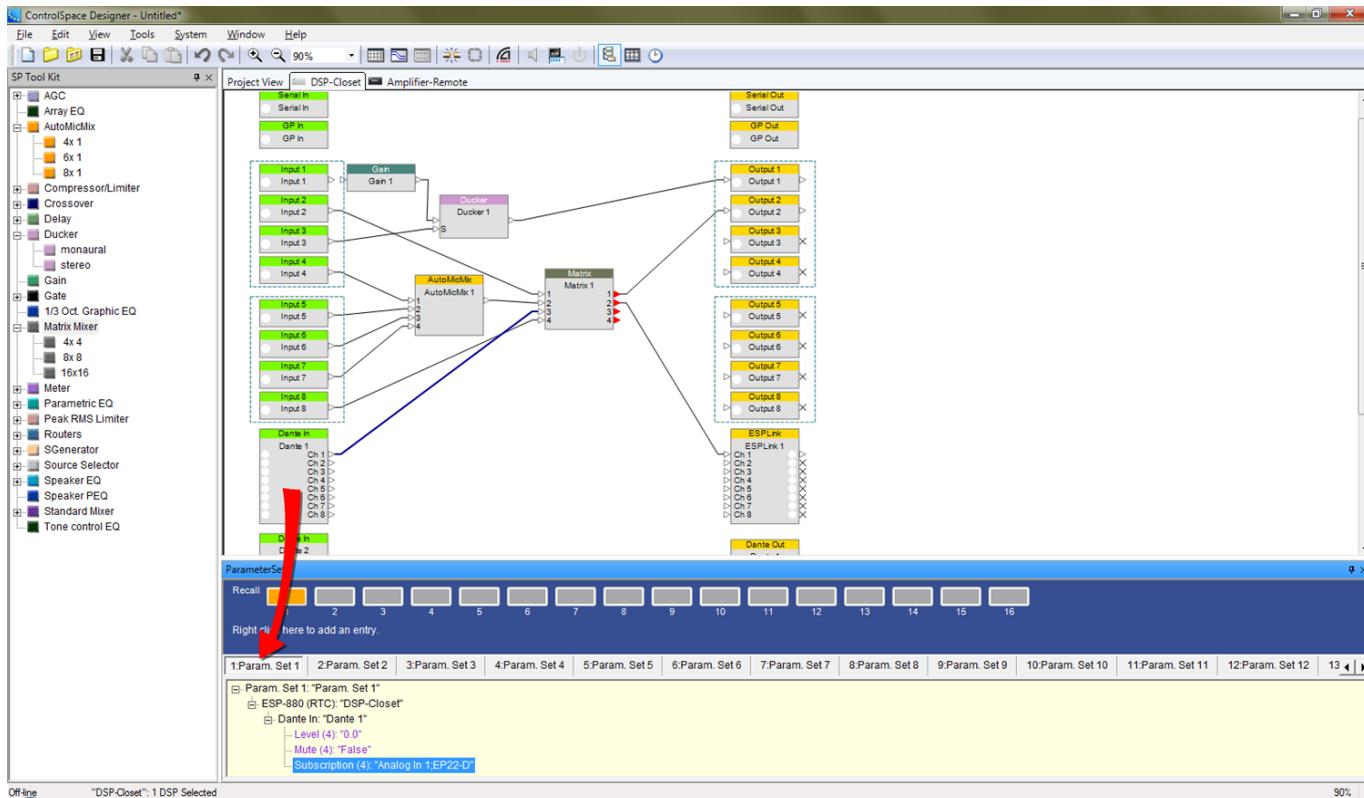
2. Set the desired channel routing using either the Matrix View or the Drag and Drop View (see Dante Network Routing).

Dante Routing - Drag and Drop View
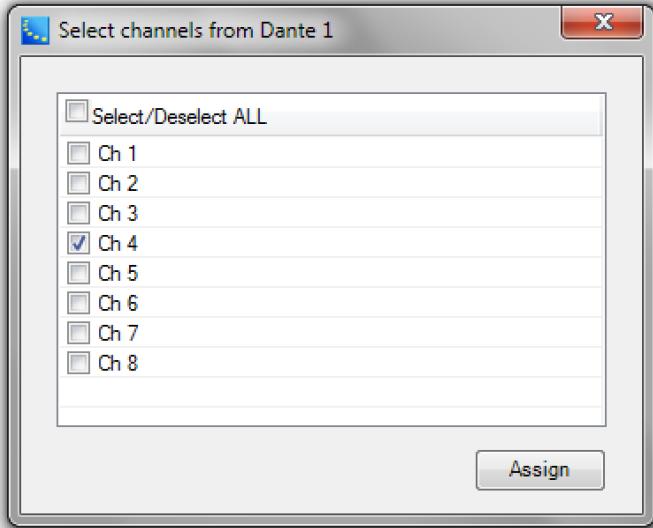
TIP: Input subscription recall only applies to either a Bose ESP processor or PowerMatch amplifier.

3. Open the signal processing view of the DSP or amplifier that has Dante input routing that you would like to store.

4. Open the parameter set window. Drag and drop the target input block into the desired parameter set. The section on Parameter Sets contains additional information and methods for programming parameter sets.

   For ESP processors, select the composite Dante input block to drag and drop.

Dragging Dante In block into Parameter Set 1
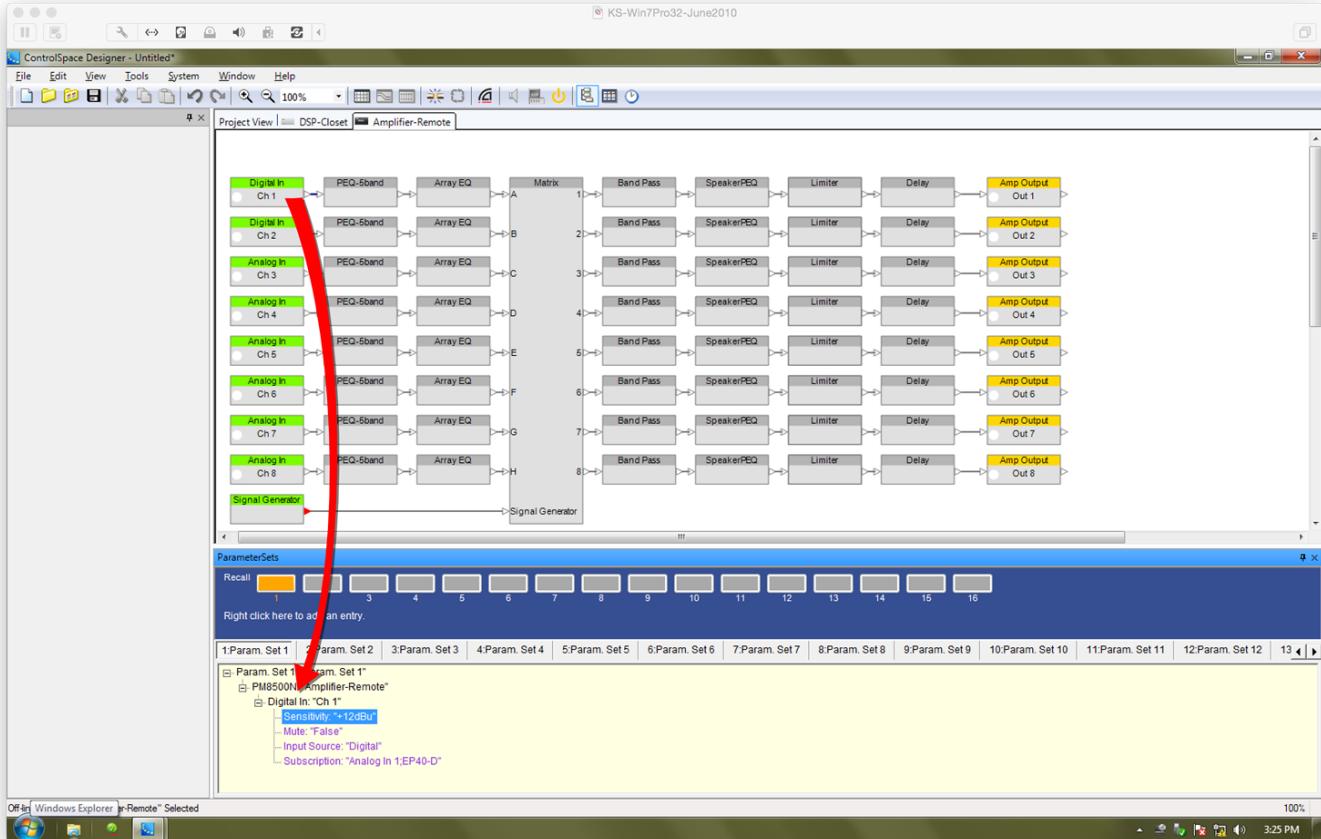
Once dropped, you will then be presented with a selection option dialog box. Select the channel or channels to which you would like to assign Dante subscription behavior.

Dante Channel Selection Dialog Box
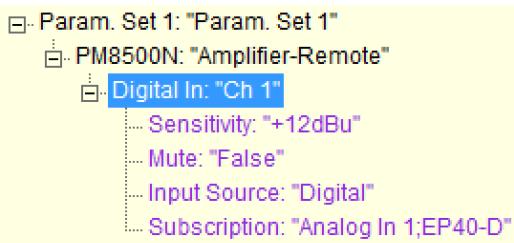
For PowerMatch amplifier, select the individual input block to drag and drop.

TIP: For PowerMatch amplifiers, ensure the desired input channel for Dante audio is set to Digital (see Input Control).
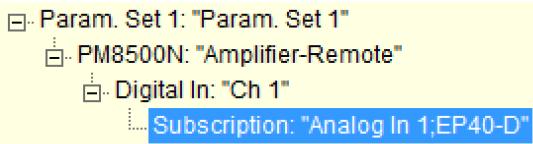
Dragging Dante In into Parameter Sets for PowerMatch Amplifiers

5. Once the Dante subscription is assigned into a parameter set, you may need to check the desired attributes of the parameter set. Expand the parameter set tree to reveal the input block parameters that were included in the drop package. Check that the correct Dante subscription is listed here. Select and delete other parameters that may not be required.

Example Parameter Set Attributes

Example Parameter Set Attributes After Removing Non-required Details

6. If desired, assign the desired parameter set(s) to user controls, timers, or serial input strings (see Control Center Programming).

7. Repeat steps 1-6 for creating different re-callable Dante subscriptions.
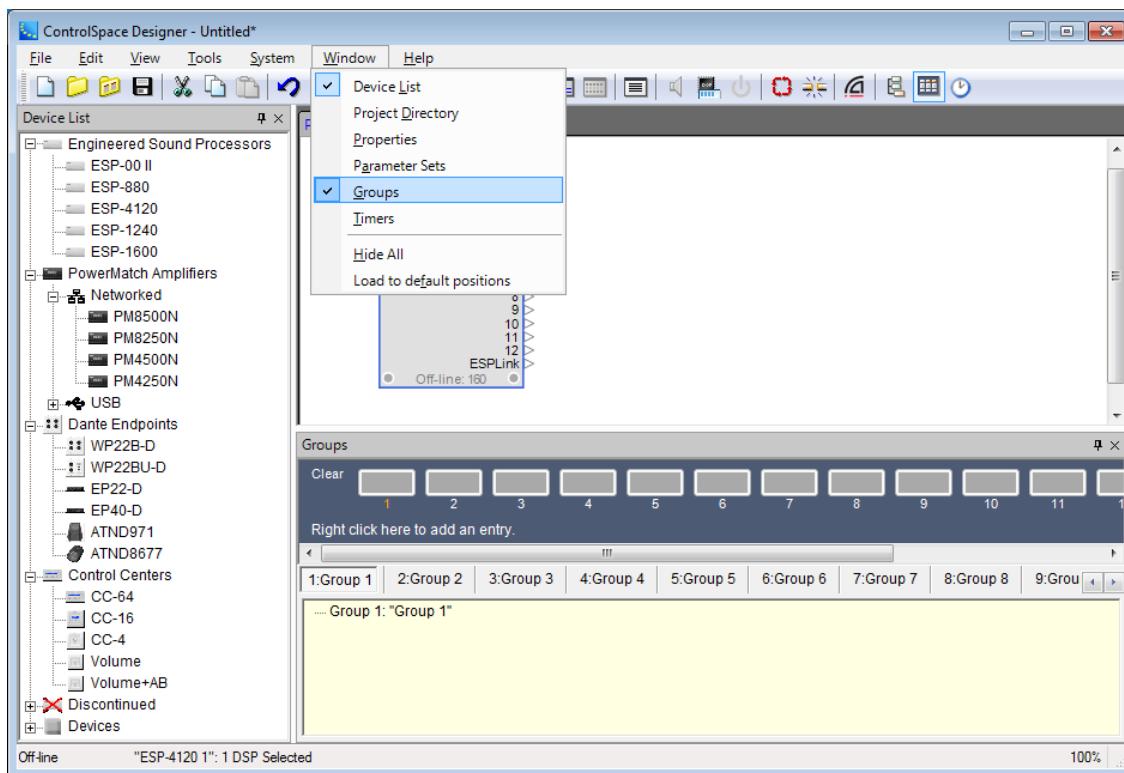
Groups

Groups link the behavior of two or more similar signal processing blocks. Two types of groups exist: *grouped gains* and *grouped signal processing blocks*.

When gain controls are grouped together, they can be controlled together by a master fader. However, the relative gain offsets of group members are maintained. When you group signal processing blocks together (such as two parametric EQs), the settings are synchronized: changes to one block affect the others in the group. Up to 128 groups may be stored.
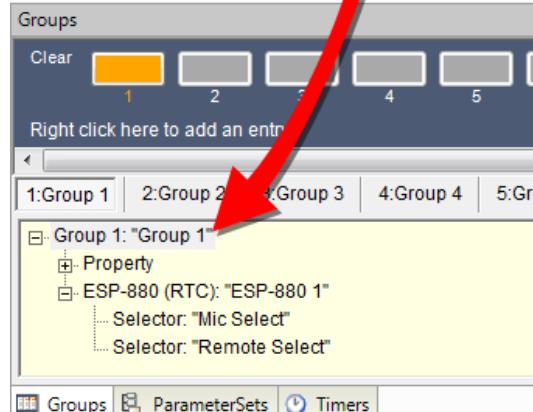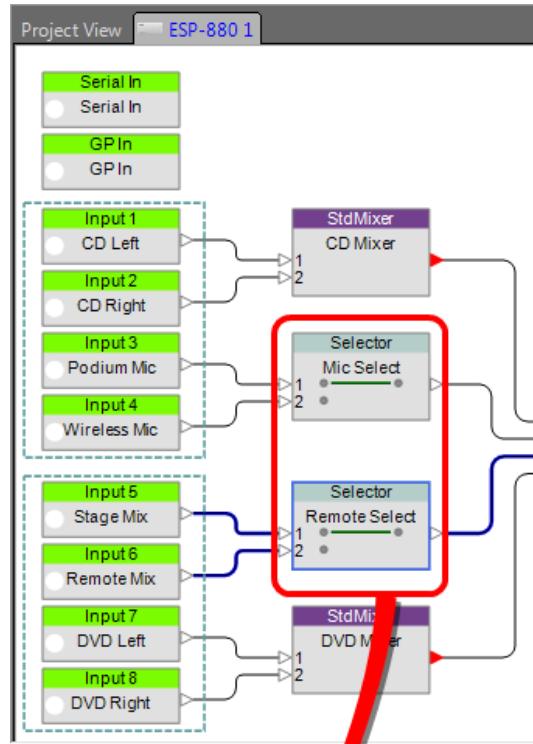
Creating a Group

Open the Groups window by accessing the Window Menu and selecting Groups from the list of available windows.
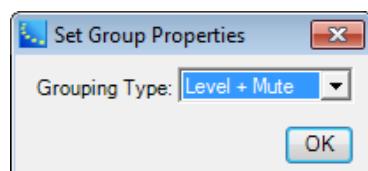
Groups window

Select the signal processing blocks in the Signal Processing View window of the device whose functions you wish to group. Drag and drop those processing blocks onto a group name in the Groups window. Only processing blocks with identical functionality may be grouped together.
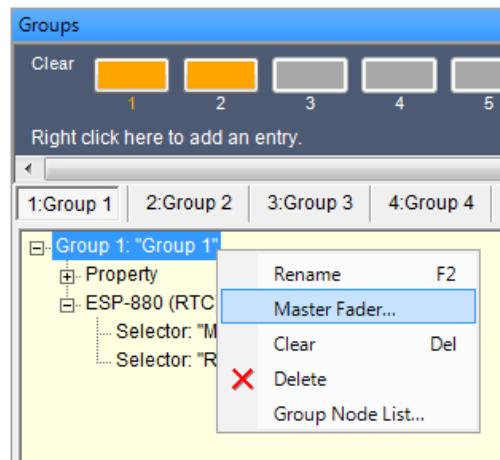
Dragging and dropping blocks into a Group

When creating groups from processing blocks that contain gain controls, i.e., inputs, outputs, and gain blocks, you are prompted to choose the properties of the group you wish to create: Level + Mute, Level, or Mute.
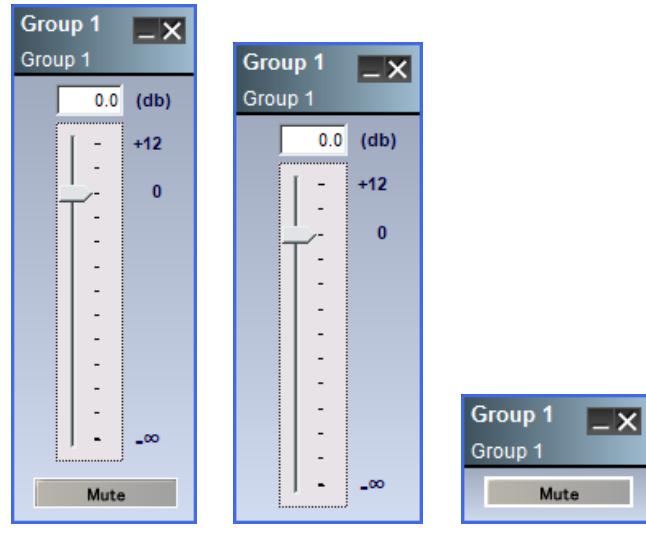
Set Group Properties

Grouped Gains are automatically assigned a *Master Fader* control panel to adjust the level and mute functions chosen in the Set Group Properties panel. To access this *Master Fader*, right click on the group name and select *Master Fader*.
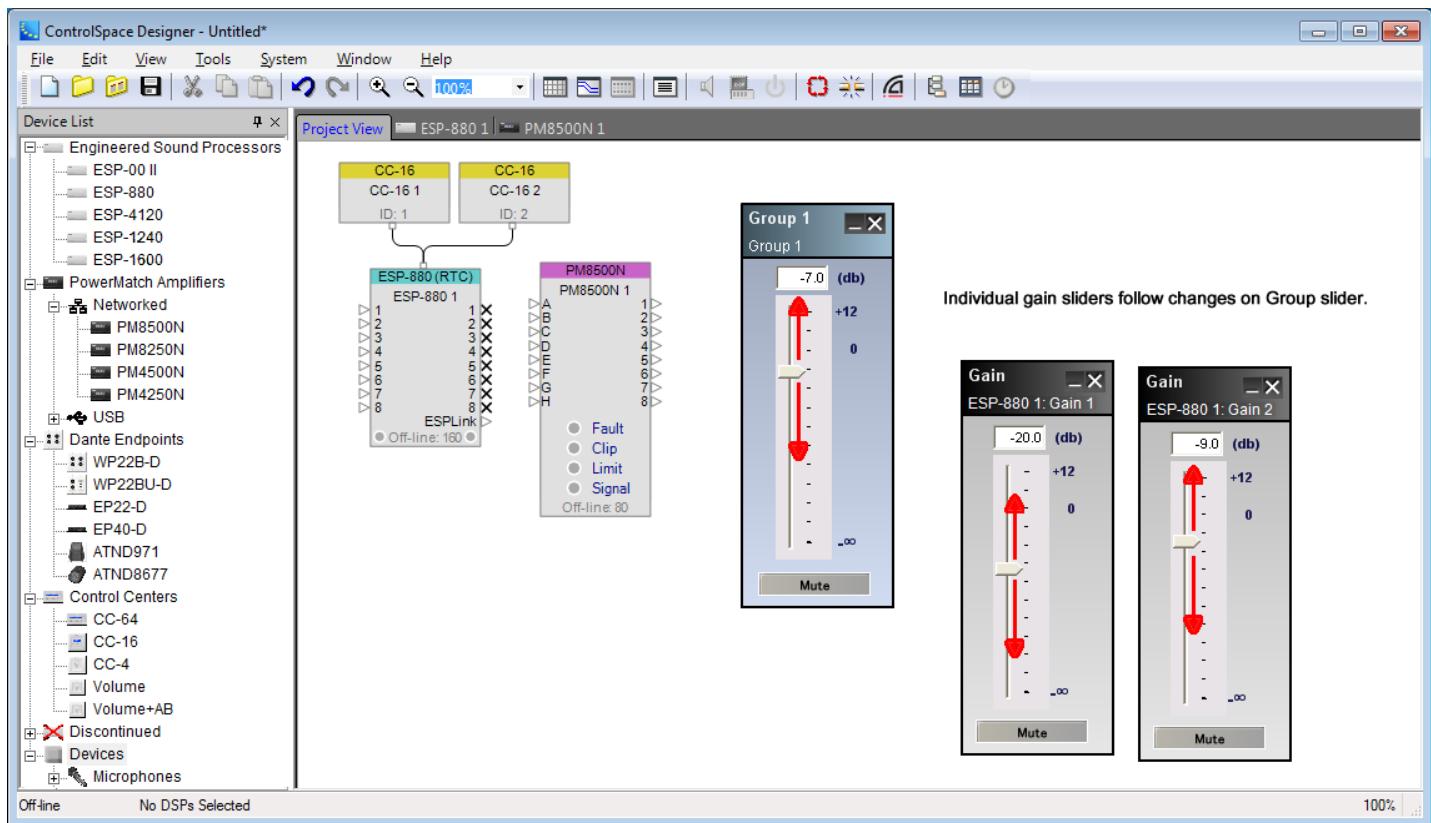
Access Group Master Fader

The appearance of each Master Fader type for Grouped Gains is shown below:

Level + Mute   *Level*   *Mute*

Verify correct behavior by opening the *Master Fader*, and each control panel for stored blocks. As you move the slider on the *Master Fader* you will see corresponding movement on the associated block gain sliders.
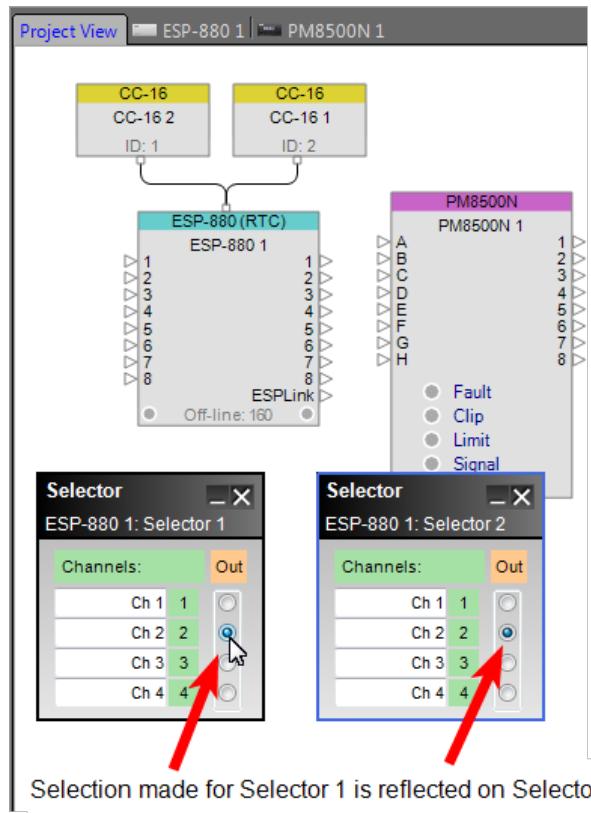
Verifying Master Fader changes on associated gains

NOTE: Grouped gain control sliders maintain relative positions when adjusting the Master Fader and you may adjust the level of an individual group member at any time. As the Master Fader is moved, an individual gain stops when it reaches its upper or lower limit, but the other gains in the group will continue to move. When the Master Fader is moved back, the relative gains are maintained as the stopped gain comes off its upper or lower limit.

When other signal processing block types (other than gain blocks) are grouped together, their settings are synchronized. Changes to one block automatically affect the others in the group. To create this type of group, select them in the ESP View then drag and drop them onto a group name in the Groups window.
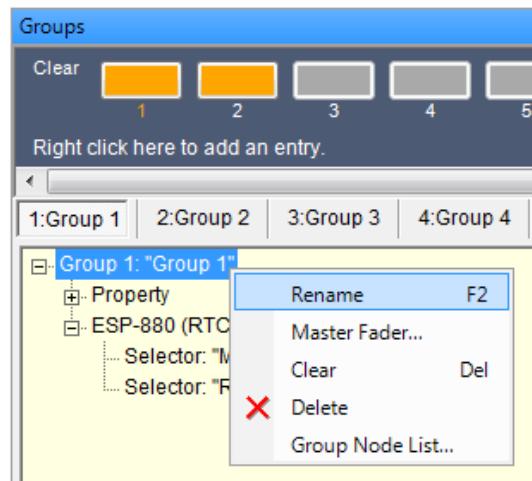
Verify correct behavior by opening each control panel for blocks stored in the group. As you adjust elements within one block, you will see corresponding movement on all other associated blocks.

Example of Synchronized Settings In Groups

Renaming a Group
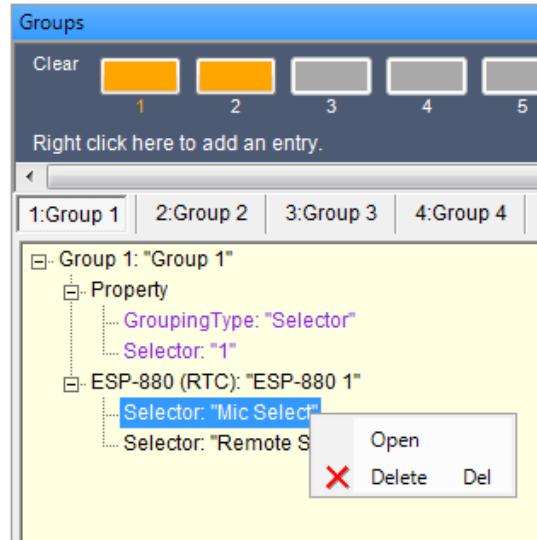
To rename the Group, select the top level of the tree structure and press F2, or right click and choose Rename.

Renaming the Group

Editing Groups

If you need to change a Group, view the contents by expanding the tree structure within the Groups window. The tree structure displays the blocks that are included in the group. Select a single block and right-click to open the block or to delete it from the group.
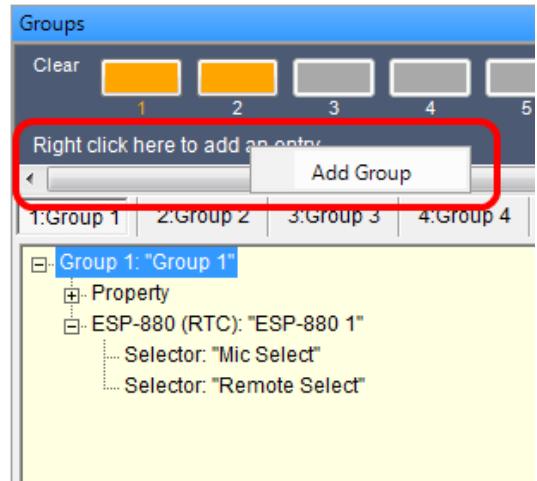
Editing the Group

Adding Groups

The default quantity of groups is 16, but additional groups may be added.

To add more groups, right-click anywhere in the blue area where the **Right click here to add an entry** text is displayed. Then click the **Add Group** pop-up option to add a new Group at the end of the list.
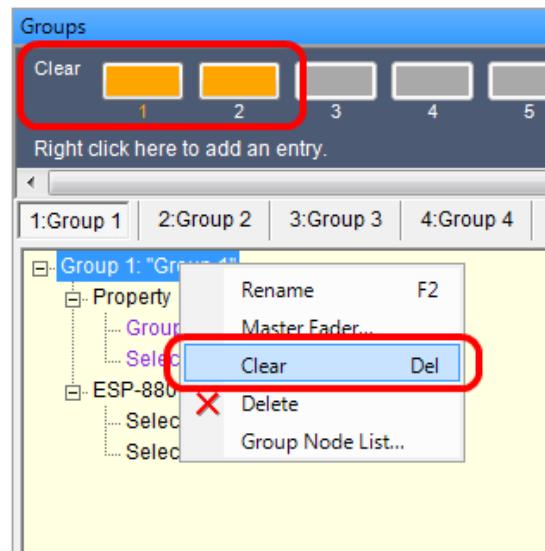
Adding a Group

Clearing Groups

To clear the programming of a group, right-click on the top level of the group's tree structure, and select **Clear**. This removes the programming but leaves the group to be used again. You can also click the orange button to clear a Group.

NOTE: Selecting Delete removes the Group and its programming.
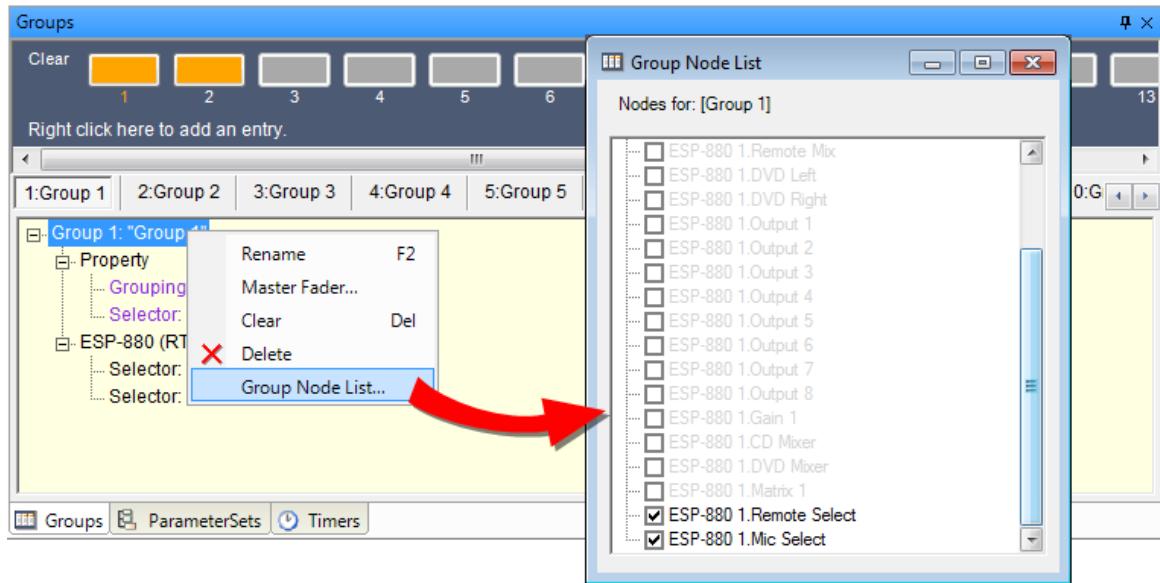
Clearing a Group

Group Node List
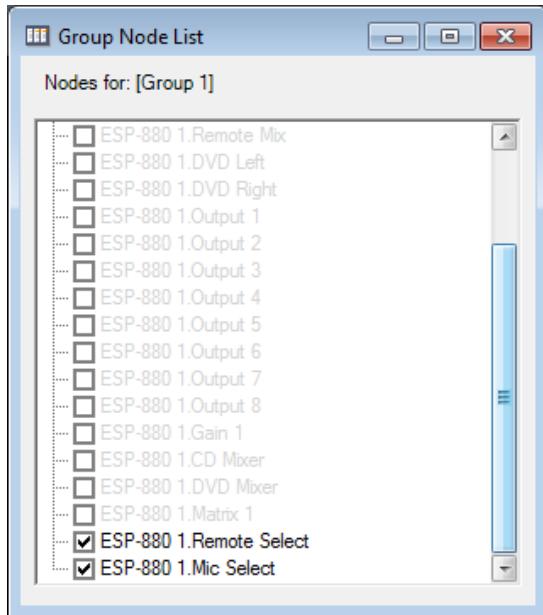
You can also create or modify a Group by using the Group Nodes List. Right click on the Group name in the Groups window and choose Group Nodes List. The Group Nodes List window opens showing all signal processing nodes in your system.

Groups may also be created or modified using the Group Node List. To access the Group Node List, double-click on the group name in the Group window. The Group Node List may also be accessed using the right-click option. Once enabled, the Group Node List window shows all signal processing nodes in your system, and indicates those assigned to the group.

Opening the Group Nodes List

When creating new Groups, you may add any processing block with identical functionality to that group. To select a given processing block, place a check mark next to the block name as shown in the following figure.

Select processing blocks for group association

Timers

Timers can be used to schedule changes that will occur in signal processing or control settings at predetermined times. You can schedule a change to take place on a specific date and time, at the same time every day, or at a time on specific days of the week. For example, you could schedule a change in source selector to take place every day at 5:00 PM.

Creating a Timer

Open the Timers window by accessing the Window Menu and selecting Timers from the list of available windows. Doing this displays the Timers tab in the Control Library. 16 timers are available for use.
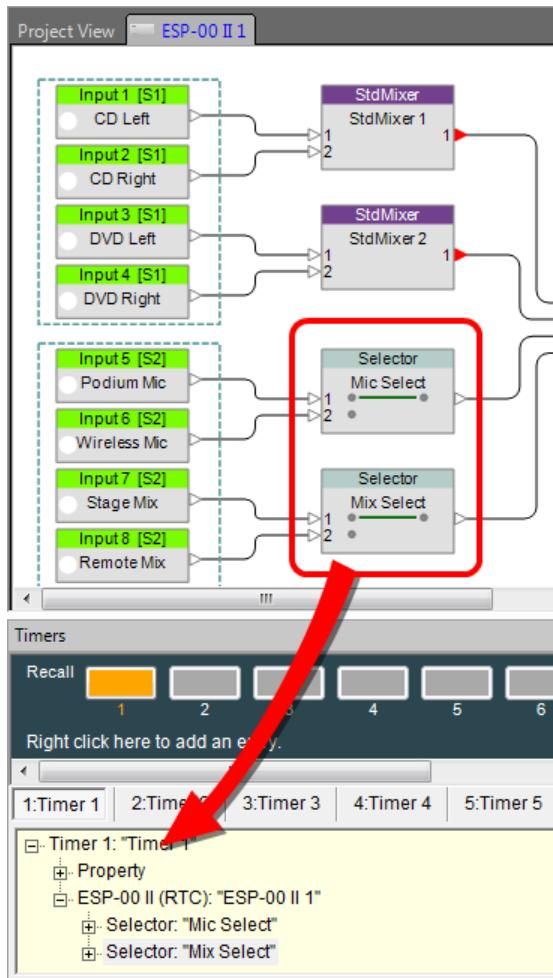
Timers tab

Select the signal processing blocks in the ESP View window whose functions you wish to include in a Timer. Drag and drop those processing blocks onto a timer name in the Timers window.

NOTE: Only Inputs, Outputs, Gains, and Selectors may be added directly to Timers. Any changes to other processing blocks can be made using Parameter Sets.

To program a new timer function:
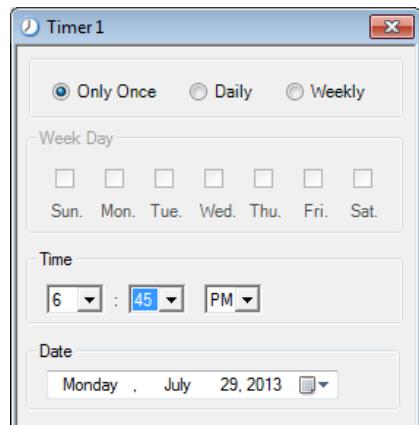
1. Configure signal processing objects you want changed at the timer occurrence.
2. Drag and drop the signal processing objects onto a timer name in the Timers window.
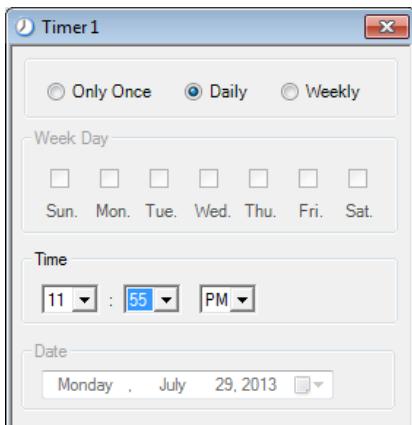
Dragging and dropping blocks into a Timer

3. Define the timer's occurrence.
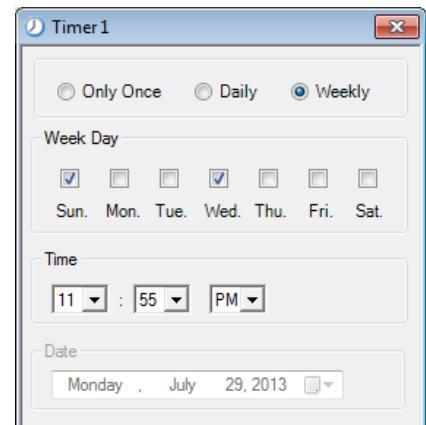
Only Once

Daily

Weekly
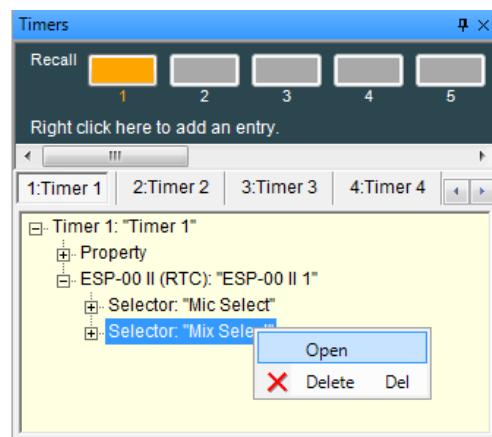
4. Test the newly programmed timer.
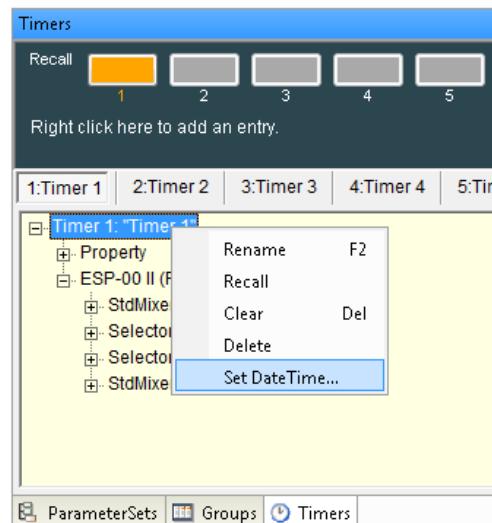
   When signal processing objects are added to a timer, the timer setup window is displayed. Select one of three timer types (Only Once, Daily, or Weekly) and then choose the remaining options available for that specific timer type.

Editing a Timer

To modify an existing timer, view its contents by expanding the tree structure within the Timers window. The tree structure displays the processing blocks included in the timer. Select a single block and right-click to open the block or to delete it from the group.
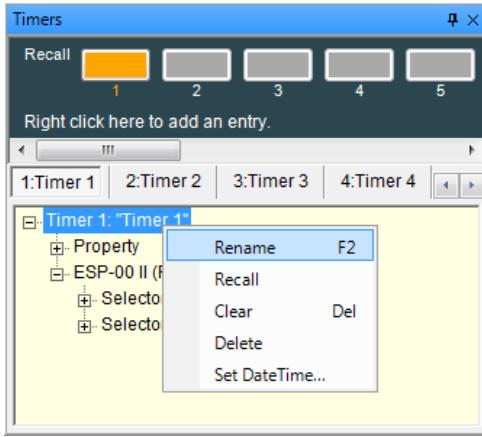
To adjust the occurrence of a Timer, right click on the timer name and select **Set Date Time...** .

Adjusting Date and Time of a Timer

Renaming a Timer

To rename the Timer, select the top level of the tree structure and press F2, or right click and choose Rename.
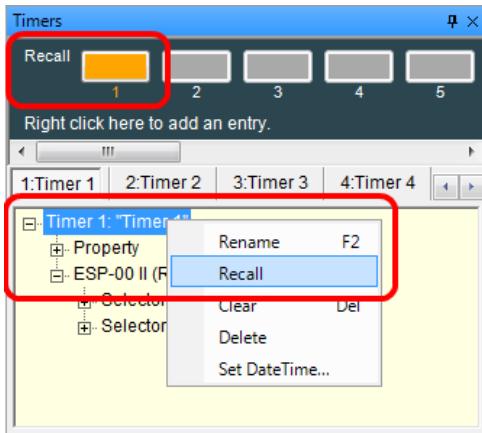
Rename a Timer

Recalling Timers

The recall buttons in the Timers window change to orange when a Timer is stored. Pressing the recall button changes the state of all signal processing blocks to the values stored in the Timer. Right clicking on a Timer name provides an alternate method of recalling a Timer.

Open the individual signal processing block control panels and then recall Timers to verify that correct settings are stored.
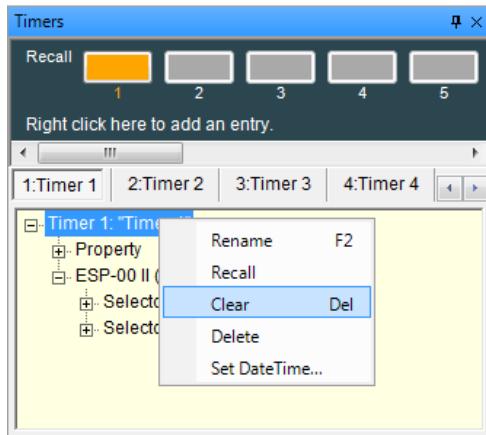
Recall a Timer

Clearing Timers

To clear the programming of a Timer, right-click on the top level of the timer's tree structure, and select **Clear**. This removes the programming but leaves the Timer to be used again. You can also click the orange button to clear the Timer.

NOTE: Selecting Delete removes the Timer and its programming.
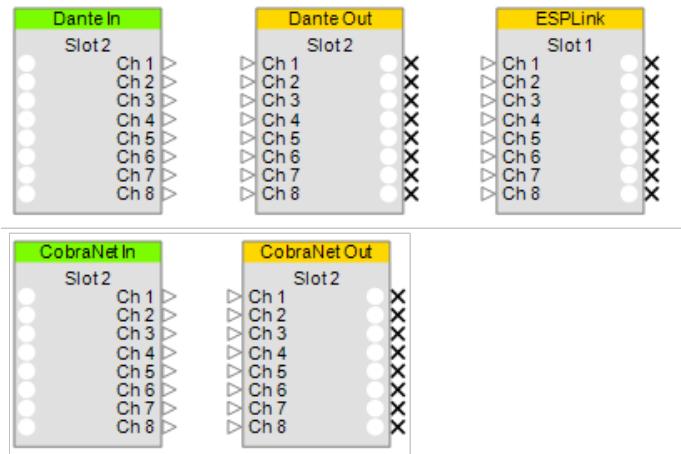
Clearing a Timer

Programming with composite device blocks
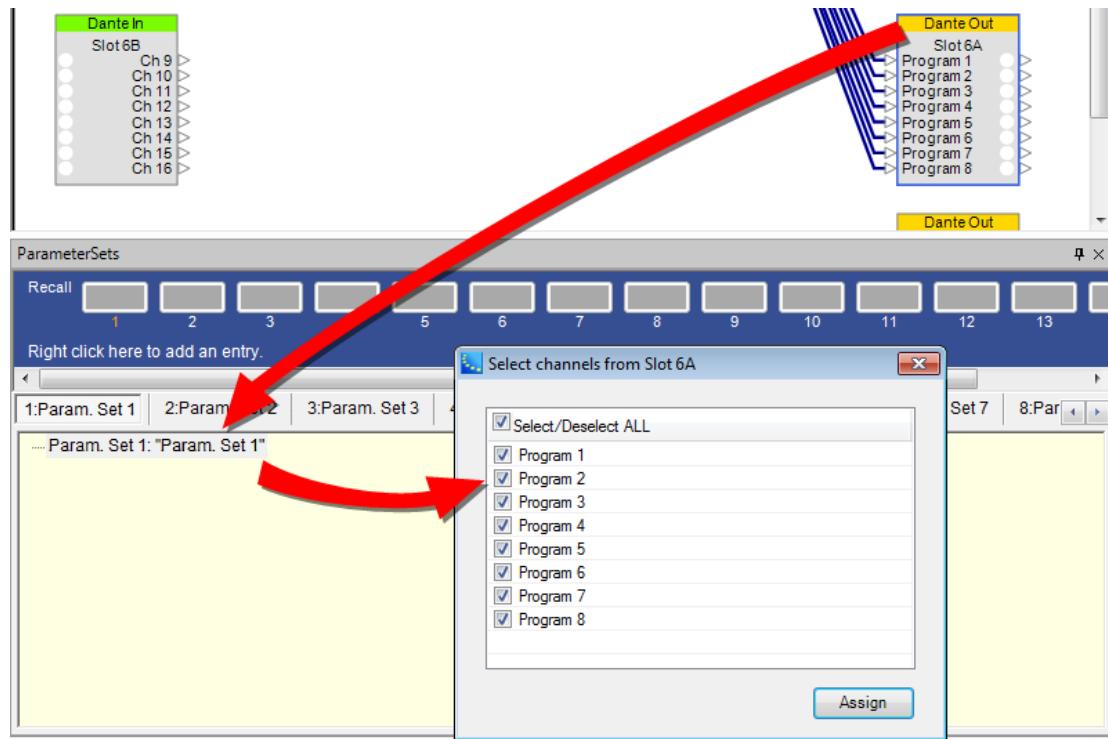
Some multi-channel devices are represented in the Signal Processing view by a composite device block. When programming Parameter Sets, Groups, and Timers with these types of devices you have the option of selecting individual channels.

NOTE: This option also exists for Serial OUT and GP OUT functions.
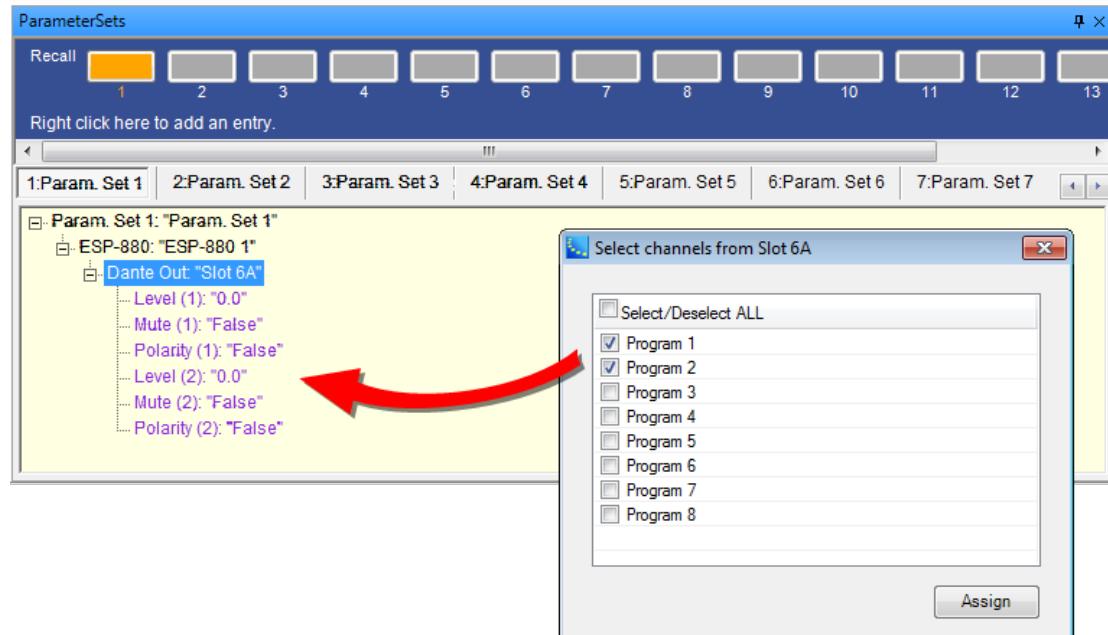
Composite device blocks

For example, when you drag and drop eight Dante output channels to a Parameter Set, a pop-up dialog give you the option of selecting the channels you want to assign to it.
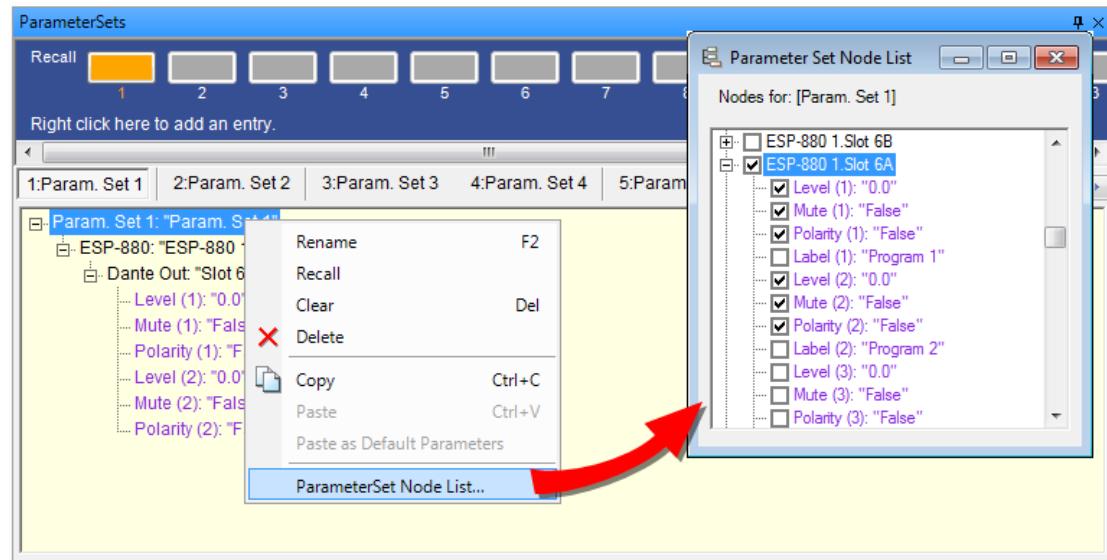
Dragging a composite block into a Parameter Set

If you select two channels and click **Assign**, only those channels will appear in that Parameter Set.

Selecting channels for a composite device

Now, if you open the Parameter Set Node List you will see only those Dante output channels selected.

Composite device channels in Parameter Set Nodes List

ESP GPIO Ports

Programming GPIO

Programming GPIO ports within an ESP system is accomplished using the same drag and drop methods described for all other signal processing and control programming. However, the source and destination of the drag and drop operations, as well as programming logic of the two types of ports, are reversed.
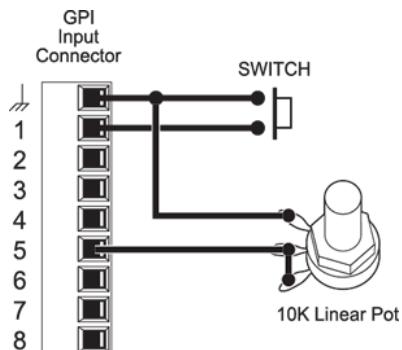
General Purpose Inputs (GPI)

With GPIs, system devices are programmed to respond to voltage changes from external equipment connected to a GPI port.
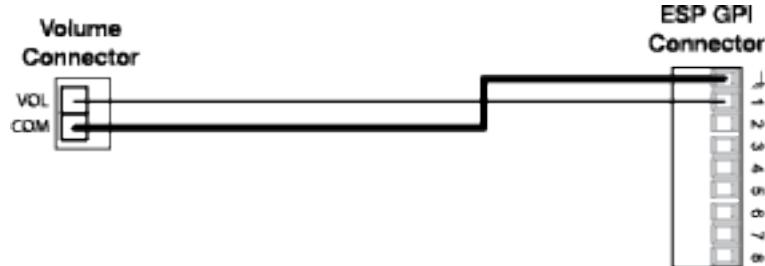
External Potentiometers and Switches
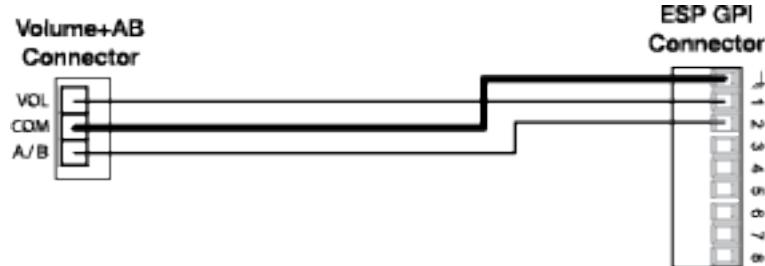
Typical GPI Device Connections Example

Bose Volume Controls
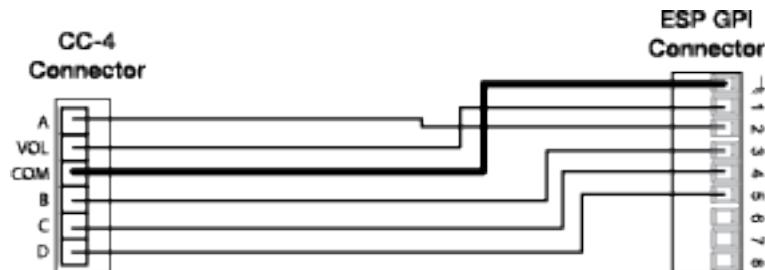
Volume Control Wiring Example

Volume Control with A/B Switch Wiring Example

"Programming Volume Controls" on page 293 for programming information.

Bose CC-4 Room Controllers
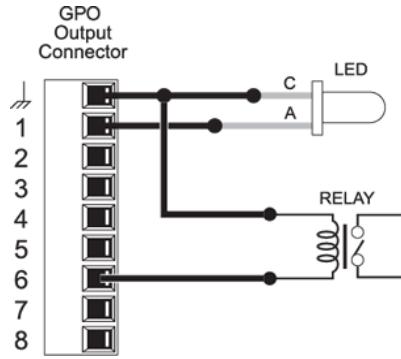
"Programming Volume Controls" on page 293 for programming information.

General Purpose Outputs (GPO)

With GPOs, internal system design changes affect the voltage supplied to GPO ports for driving external equipment.

"Programming GPO" on page 287 for programming information.
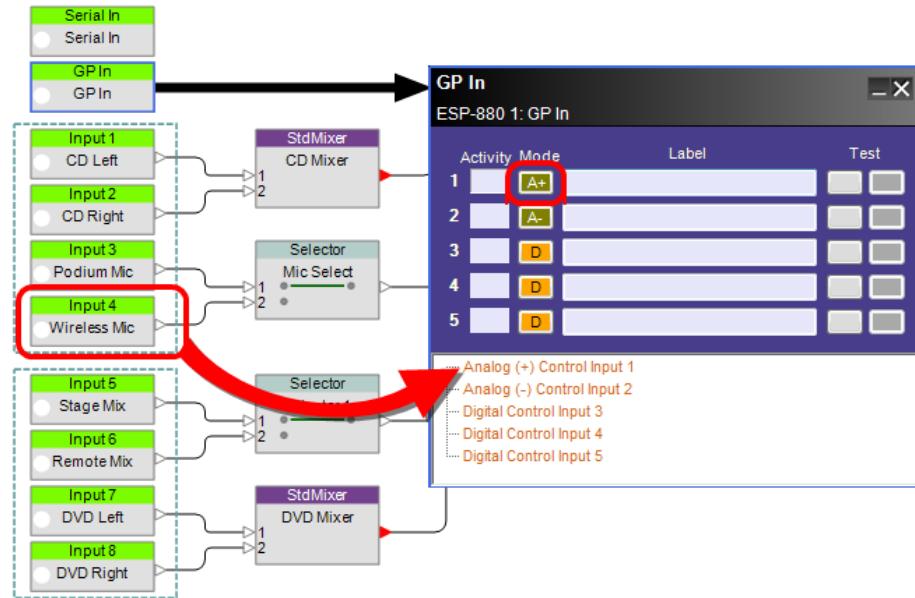
Typical GPO Device Connections Example

Programming GPI

Configure the GPI port control mode then drag and drop processing blocks from the ESP View or Control Library to text lines in the programming tree of the GPI control Panel. Refer to GPIO for a description of operating modes.

Analog Mode
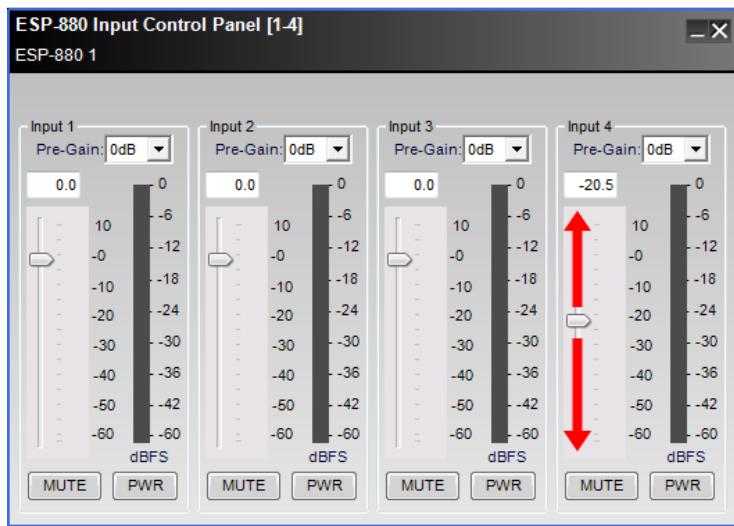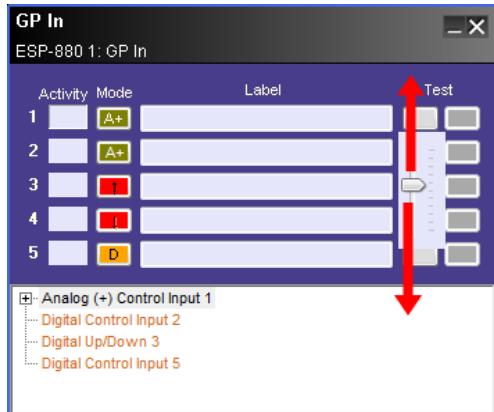
To program an Analog GPI port mode with a potentiometer connected to GPI port 1 to control a gain stage, adjust the GPI mode to *Analog* then drag the gain block onto "Analog Control Input 1:"

Assigning an input gain block to an Analog GPI port

Testing the operation of this GPI programming within software is accomplished by opening the input gain control panel and right clicking the test button directly beneath the GPI control panel input mode button to gain access to a virtual test slider.
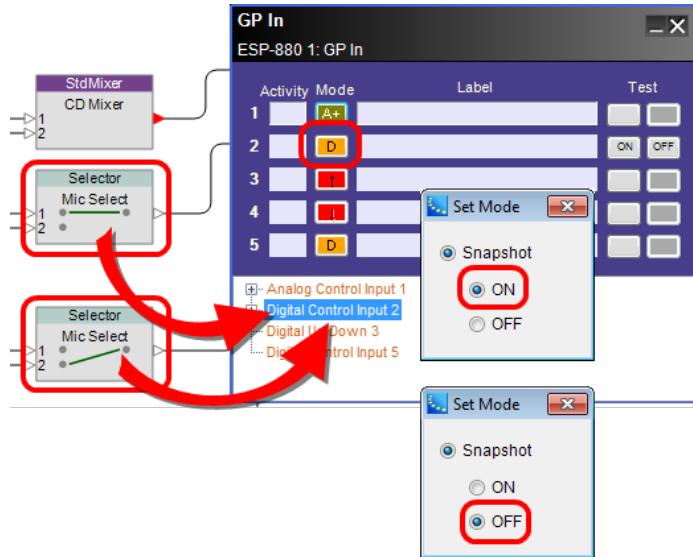
Move the test slider up and down to verify corresponding movement occurs on the gain control. When physical hardware is present and connected, you will see similar movement on the gain control by rotating the potentiometer in the field.

Testing Analog GPI port programming

Digital Mode
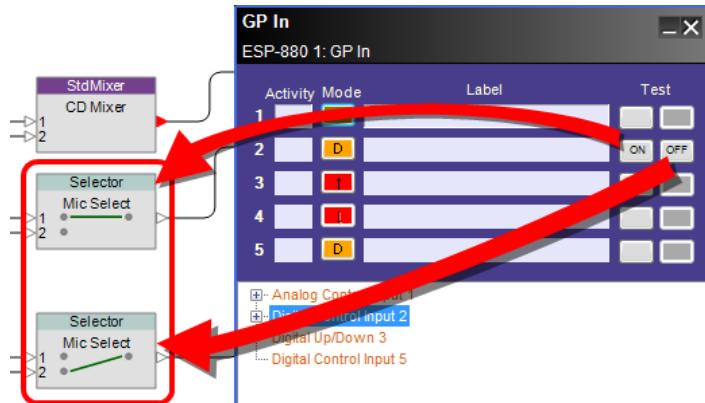
To program a Digital GPI port mode with a latching closure connected to GPI port 2, adjust the GPI mode to *Digital* then drag a selector to "Digital Control Input 2:" This GPI mode stores two Snapshot conditions to match normally open and normally closed switch conditions. Close the Snapshot Set Mode panel after the first drag operation to define the ON condition, adjust the selector to the alternate position, then drag and drop the selector back on to "Digital Control Input 2:" This becomes the Snapshot Set Mode OFF condition.

Assigning a selector block to a Digital GPI port

Testing the operation of this GPI programming within software is accomplished by viewing the selector control panel while left clicking the test buttons directly beneath the control input mode button to simulate switch actions.
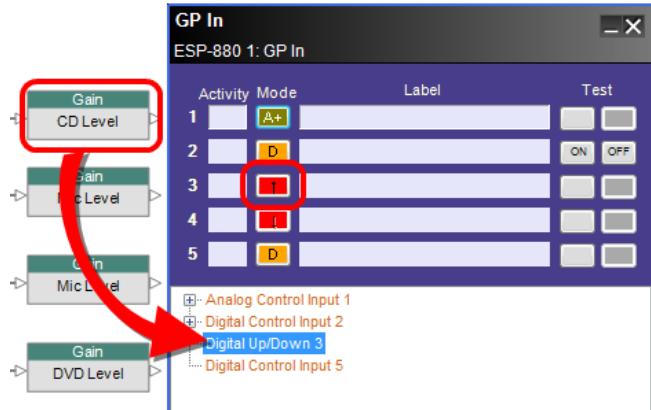
Push the ON test button to verify corresponding movement occurs in the selector. Repeat this to verify selector for the OFF test button. When physical hardware is present and connected, you will see similar movement on the selector by activating the switch in the field.

Testing Digital GPI port programming

Digital Up/Down Mode
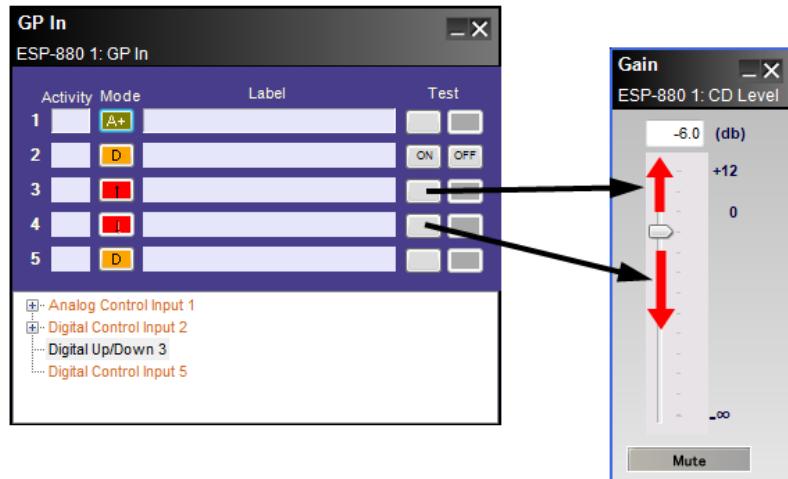
To program a Digital Up/Down GPI port mode with two momentary switches connected to GPI ports 3 & 4, adjust the GPI mode to *Digital Up/Down* then drag a gain block onto "Analog Control Input 3:" Digital Up/Down mode replicates rotary gain control movement with one push button to increase level and another to decrease level. As a result, this mode occupies two positions in the GPI control panel.

Assigning a gain block to a Digital Up/Down GPI port

Testing the operation of this GPI programming within software is accomplished by opening the input gain control panel and left clicking the test button directly beneath each GPI control panel input mode button to simulate switch push button actions.

Press the test buttons to verify corresponding movement occurs on the gain control. When physical hardware is present and connected, you will see similar movement on the gain control by pushing the physical buttons in the field.
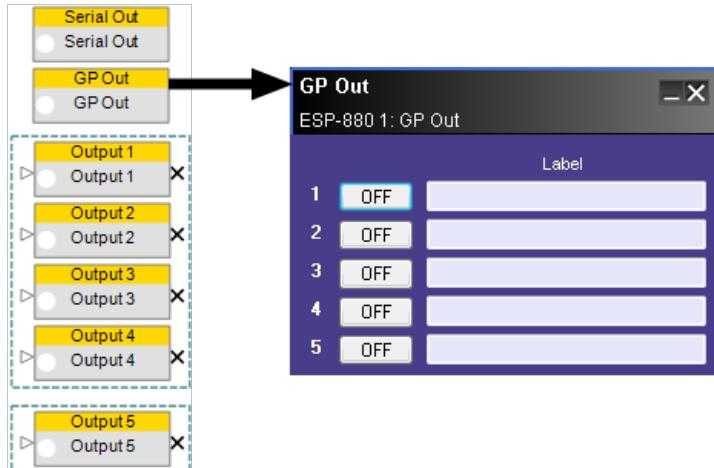
Testing Digital Up/Down GPI port programming

Programming GPO

General Purpose Outputs are activated by parameter set or timer and two methods exist for programming them. The first method is to use the Project Directory and the second method is to use the Parameter Set Nodes List.
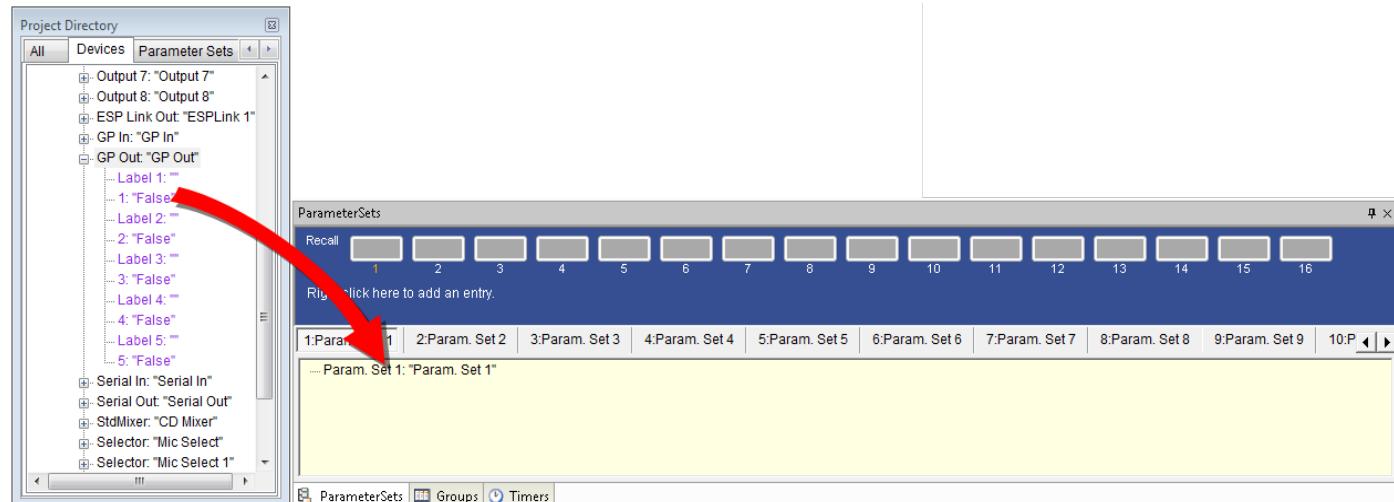
For each of the two methods, the first step is to open the GPO control panel and set the state the desired output to either ON or OFF.

Open & Enable General Purpose Outputs

Using the Project Directory
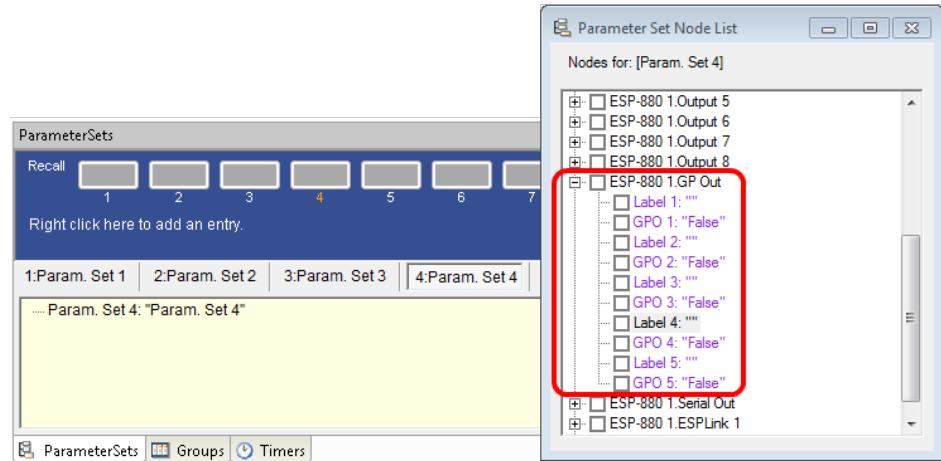
Using the Project Directory, expand the GPO section within the ESP device tree and drag the specific output of interest into a parameter set or timer. When that parameter set is invoked or the timer activates, the GPO will change its state to the programmed value (ON or OFF).


Project Directory GPO Drag & Drop to Parameter Set

Using the Parameter Set Nodes List

Right click on a parameter set name in the Parameter Set window and select the Parameter Set Nodes List. Place a check mark next to the desired GPO ports in the ESP device tree to store in the parameter set.

Parameter Set Node List GPO Programming

Serial Port Programming
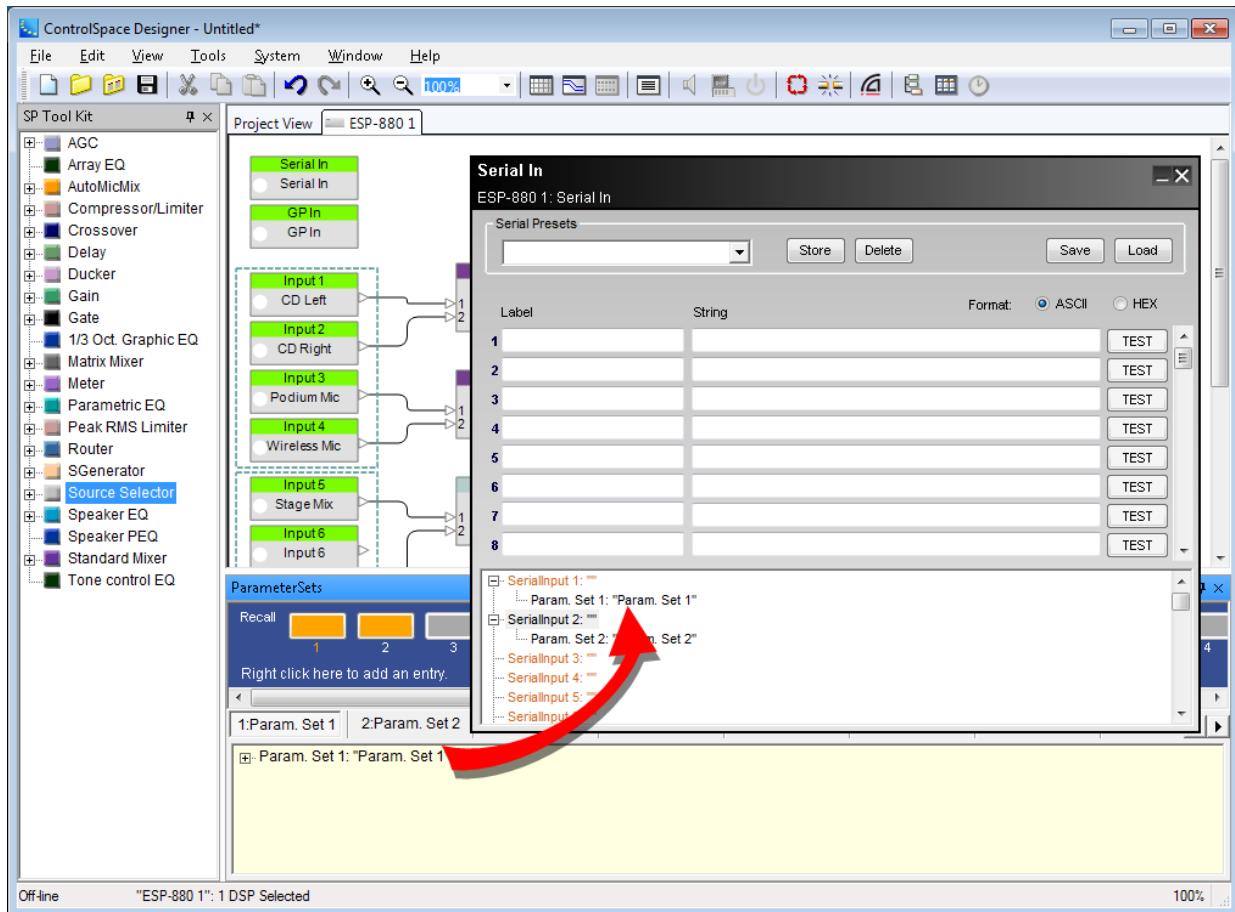
ControlSpace® engineered sound processors will respond to and send serial messages via either the serial port, located on the rear panel of the ESP, or the Ethernet network.

The hardware serial port for the ESP-88/00 II is configured for 38,400 baud (115,200 for the ESP-880/1240/4120), no parity, 8 bits, 1 stop bit, and no flow control.

Serial inputs may be programmed to invoke an action in a device when a serial command is received from an external device. Serial outputs may be programmed to send a serial command to an external device when a parameter set is invoked, or when a timer activates.

Serial Inputs

ControlSpace ESP systems may recall a snapshot of a block, or invoke a parameter set when a serial string is sent to the serial port. To program a Serial Input, open the **Serial In** control panel from ESP View and drag and drop one or more blocks or parameter sets onto a text line in the programming tree.

*Input strings "S1" and "S2" invoke parameter sets*
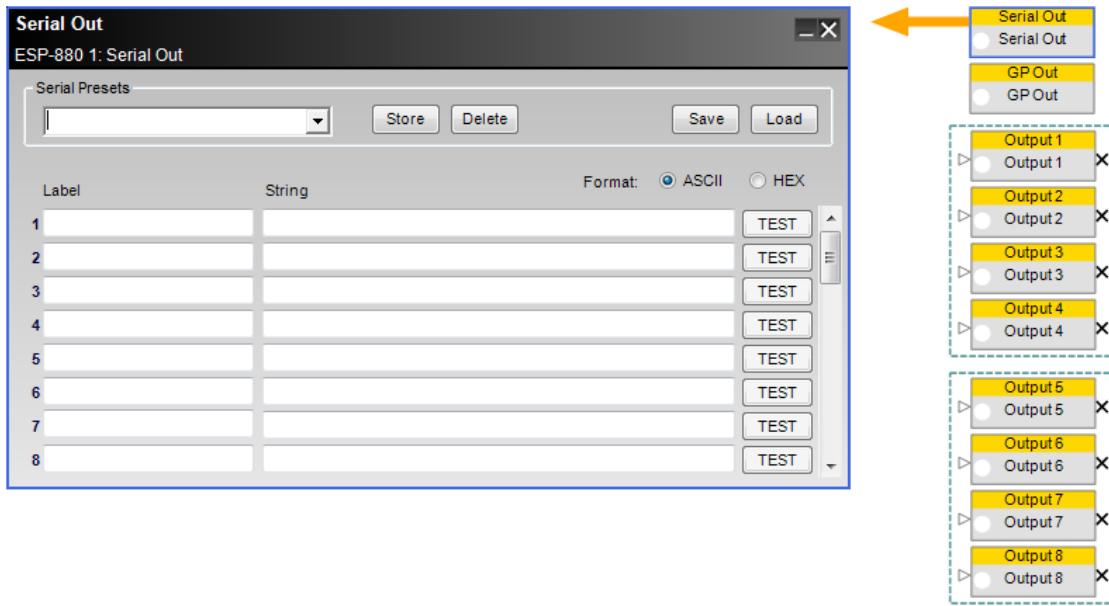
Enter the serial string of characters in the corresponding field in the upper half of the control panel. When the incoming serial string matches any of the eight strings entered, the block or parameter set programmed for that string is invoked. For example, receipt of the ASCII string "S2" from an external system indicates that "scene 2" is selected, and ControlSpace should invoke the programmed signal processing block or parameter set.

Test buttons on the Serial Input control panel are used to simulate the incoming serial string and verify programming is operating as intended.

Serial Outputs

The serial output device is used to transmit a serial string out the port when a parameter set is invoked, or when a timer activates.

To open the Serial Output control panel, double-click on the **Serial Out** block in ESP View.
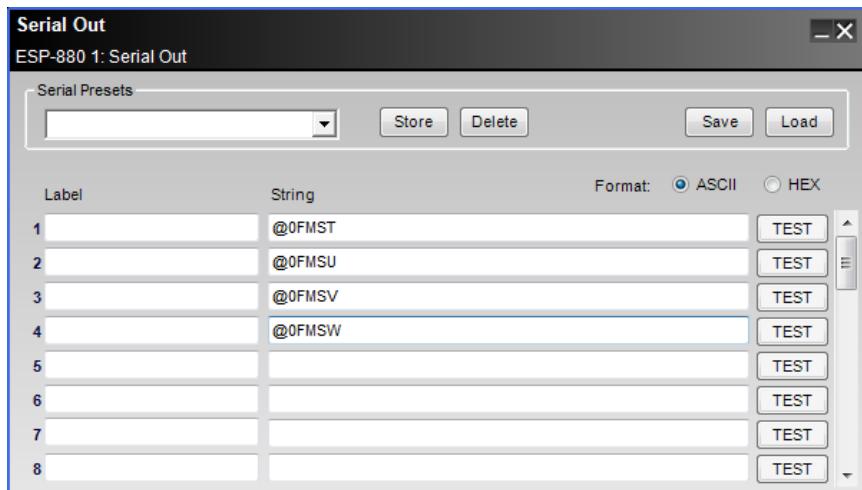
Opening the Serial Output control panel

There are two ways to program a Serial Output which are similar to programming a GPO:

- Using the Project Directory
- Using the Parameter Set Nodes List
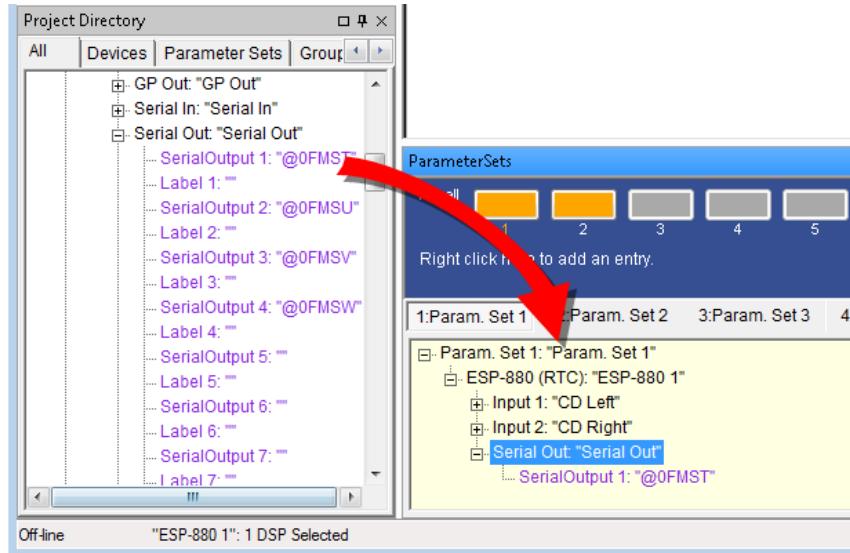
For each of the two methods, the first step is to open the **Serial Out** control panel and enter the serial command strings to provide the desired device control.


Serial Output Commands

Using the Project Directory
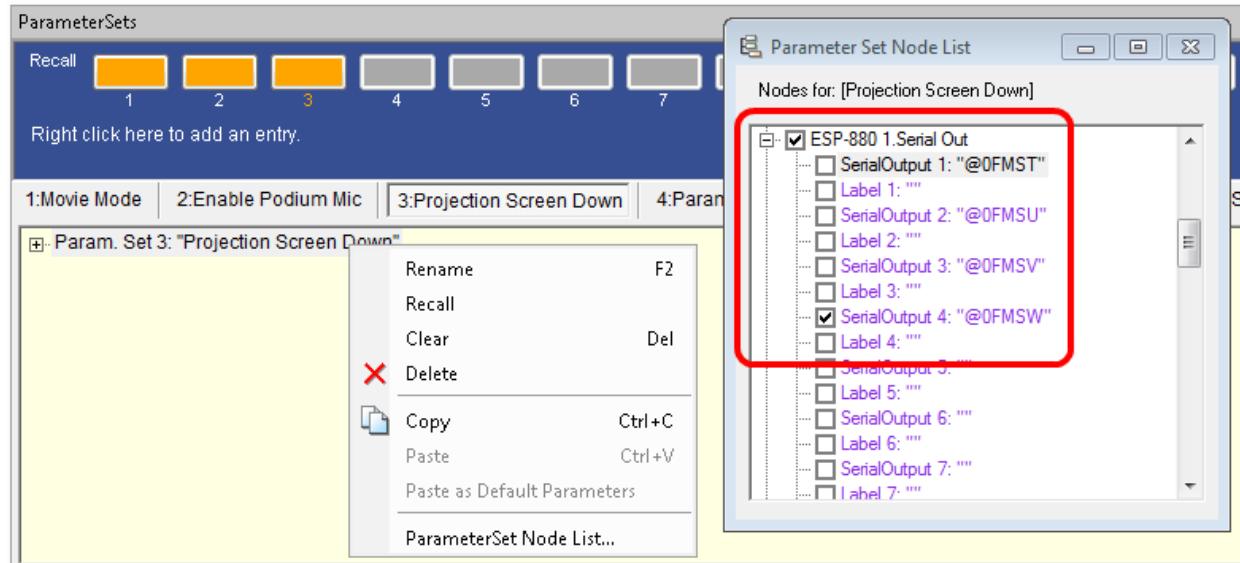
After typing the serial string or command into the Serial Output control panel, find the Serial Output in the Project Directory, and drag it into a parameter set or timer. When the parameter set is invoked, or the timer activates, the Serial string is sent out the Serial port on the ESP. For example, you could send a signal to a video switcher when a parameter set is invoked or a timer expires.

Using Project Directory to Program Serial Output

Using the Parameter Set Nodes List

Right click on a parameter set name in the Parameter Set window and select the Parameter Set Nodes List. Place a check mark next to the desired Serial Output ports in the ESP device tree to store in the parameter set.

Parameter Set Node List Serial Output Programming

Note: The ESP automatically assumes that each input string is terminated with one carriage return (CR). You must program the equipment sending the serial string to the ESP to terminate the serial string with one.

Note: You must use hex when designating a control character like CR or LF. To designate a hex character, use backslash 0, then the hex value of the character (0-F).

Control Centers

Control Center Programming

ControlSpace Designer software allows for a great amount of flexibility in how the user will control the system. The amount of programmed control depends on the system design, and the needs of your customer. Your system might be a static signal processing tool, and require no user controls, or it might be a multi-room, multi-zone solution requiring CC-4, CC-16, and CC-64 controllers, along with general purpose switches and potentiometers.

For information on programming these controllers, see:

[Programming Volume Controls](#)

[Programming CC-16 Zone Controllers](#)

[Programming CC-64 Control Centers](#)
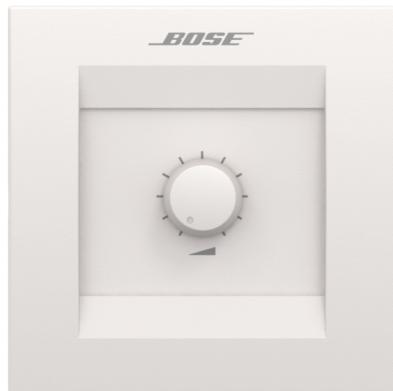
Programming Volume Controls

The following provides programming information for the Bose Volume Control, Volume Control with A/B switch , and CC-4 Room Controller interfaces. They are all designed to connect via GPI ports.

For details on connection to GPI ports, see Programming GPIO.
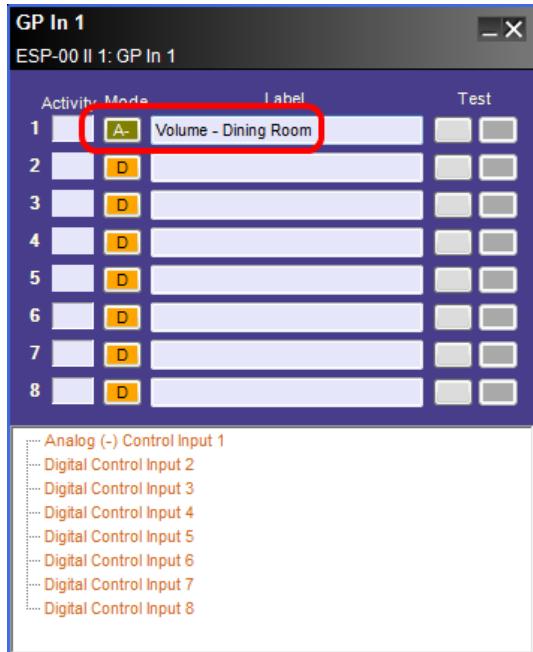
For details on programming GPI ports, see Programming GPI.

Volume
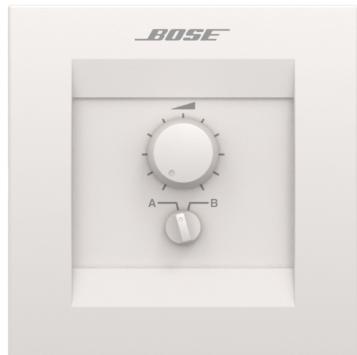
ControlSpace Designer supports the following programming features via the GPI port for the Volume control:

Volume Control – Drag and drop any gain block to an analog mode control for the GPI port to which this volume control is wired. Be sure to select the **A−** mode for the volume control. The **A−** mode should be used for a potentiometer that is 0 ohms when fully clockwise (10 kohms when fully counter-clockwise) – this is how the volume control operates.

*GPI Control Panel Example for programming the Volume control*
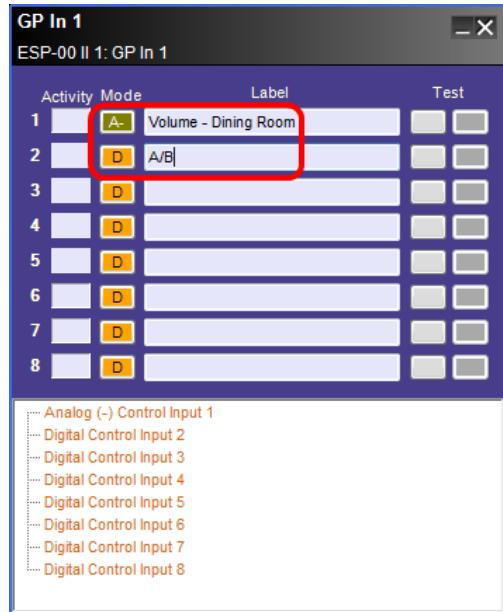
Volume + A/B

ControlSpace Designer supports the following programming features via the GPI port for the Volume+AB control:
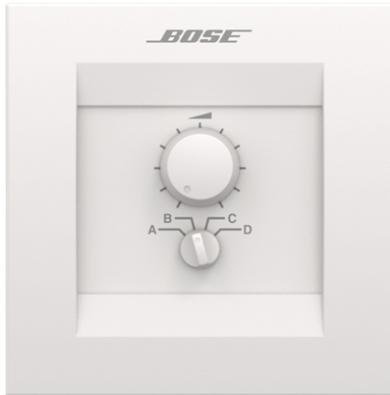
Volume Control – Drag and drop any gain block to an analog mode control for the GPI port to which this volume control is wired. Be sure to select the **A–** mode for the volume control. The **A–** mode should be used for a potentiometer that is 0 ohms when fully clockwise (10 kohms when fully counter-clockwise) – this is how the volume control operates.

Selector Switch – Drag and drop any parameter set to two individual digital mode GPI controls for each switch position, A or B.

GPI Control Panel Example for programming the Volume+AB switch control
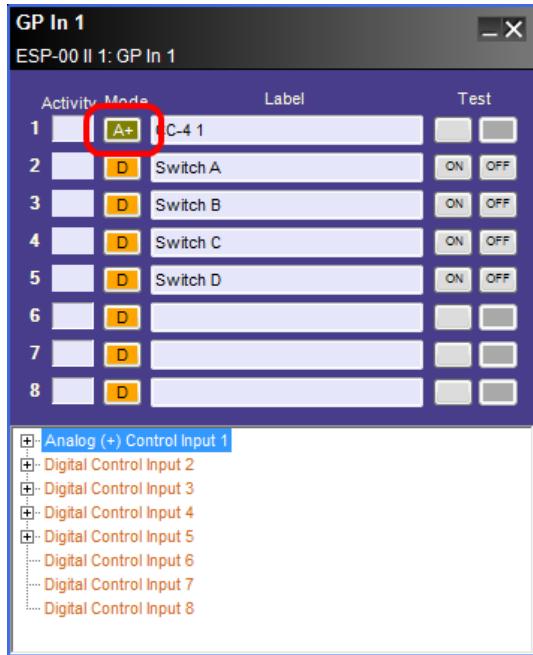
CC-4 Room Controllers

The CC-4 Room Controller has no dedicated control panel within ESP View. It has a Project View icon only. However, it supports the following programming features via the GPI port:

Volume Control – Drag and drop any gain block to an analog mode control for the GPI port to which this volume control is wired. Be sure to select the **A+** mode for the CC-4 controller. The **A+** mode should be used for a potentiometer that is 0 ohms in the full counter-clockwise position (10 kohms when fully clockwise) – this is how the CC-4 room controller operates.
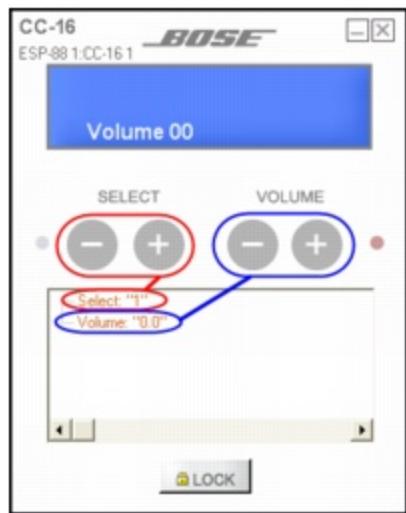
Selector Switch – Drag and drop any parameter set to four individual digital mode GPI controls for each switch position, A through D.

CC-4 Programming via GPI Analog and Digital Modes

Programming CC-16 Zone Controllers

Once a signal processing design is complete, programming associated controllers is accomplished using the same drag and drop methods as discussed in previous sections. Open the CC-16 Smart Simulator by double clicking on its Project View icon.

Programming tree functions of the CC-16 Smart Simulator

The buttons on the CC-16 can be programmed with the following objects:
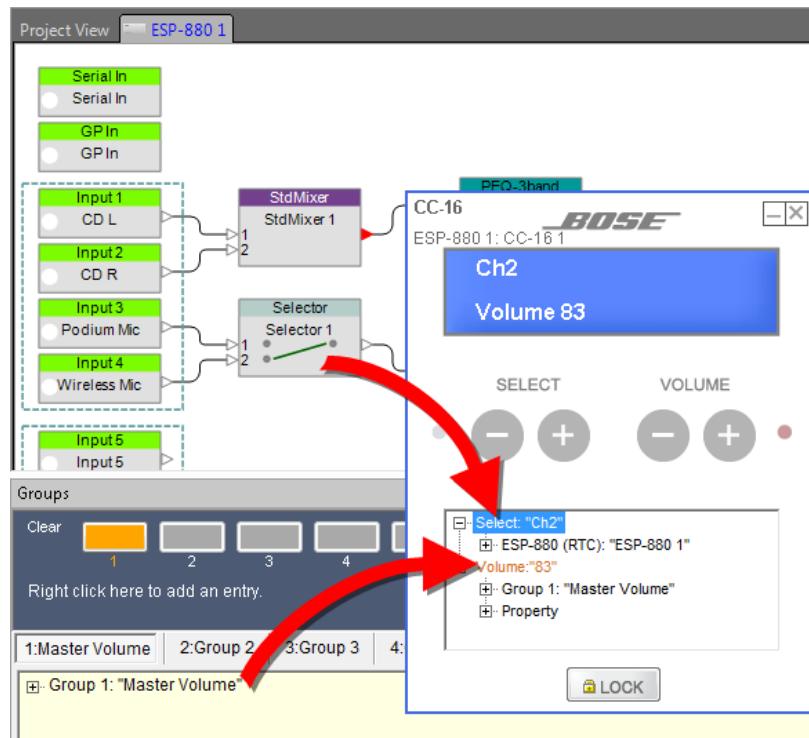
SELECT buttons:

- Selector blocks
- Parameter sets

VOLUME buttons:

- Gain blocks (including Input and Output blocks)
- Groups of gain blocks

Select one of the appropriate block types listed above for use within the CC-16 Select buttons within ESP View. Then drag and drop that processing object onto the Select entry in the CC-16 programming tree. Repeat this process for a gain or grouped gain for Volume entry programming.
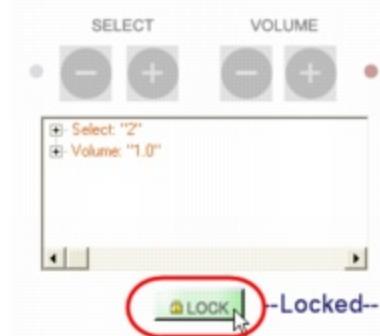

Assigning functions to CC-16 buttons

NOTE: Labels for the CC-16 display are inherited from the individual blocks, parameter sets, and groups. If the name is modified after adding the item to the CC-16, it must be re-assigned to the CC-16 for the new name to be applied.
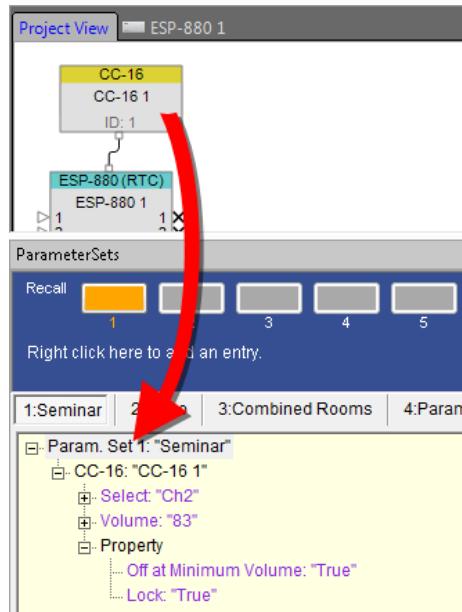
Locking the CC-16

When locked, the select and volume control buttons of the CC-16 are disabled. The lock/unlock status of a CC-16 must be stored in two unique parameter sets, one for lock and one for unlock. When either parameter set is invoked, the CC-16 is either locked or unlocked accordingly.

To store the lock/unlock status in a parameter set, first set the lock button on the CC-16 Smart Simulator to the locked or unlocked state, then drag the CC-16 from Project View into a parameter set. The lock status is the only CC-16 setting that is stored in the parameter set.
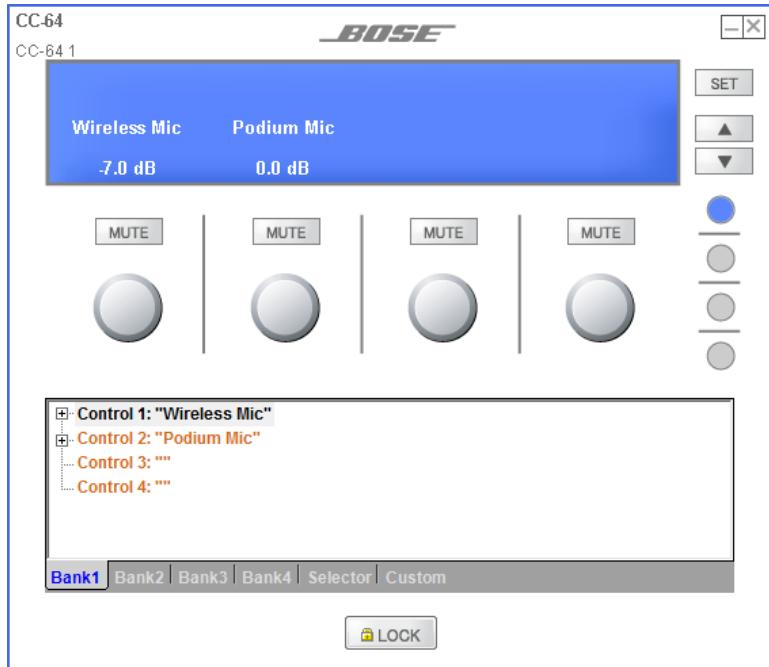

Setting the lock button on the CC-16 Smart Simulator

Dragging the locked CC-16 into a parameter set

Programming CC-64 Control Centers

The programming tree in the lower half of the CC-64 Smart Simulator is used for assigning functions to the controls on the CC-64.

*Programmable Controls for Bank1*
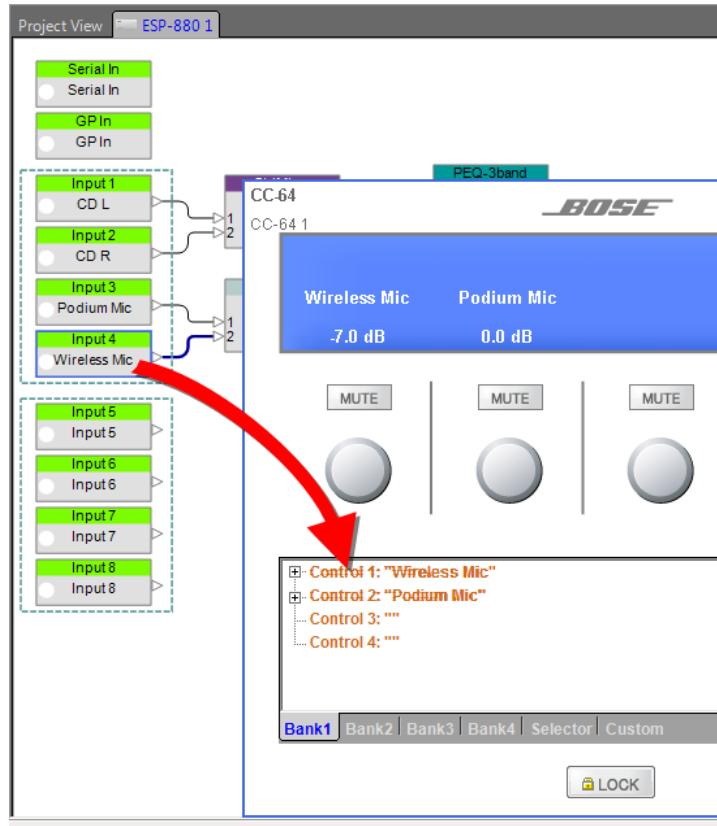
This control center may be programmed to control or invoke the following objects:

- Gain blocks (including Input and Output blocks)
- Grouped Gain blocks
- Selector blocks
- Parameter sets
- Select signal processing blocks using custom settings

Once a signal processing design is complete, programming associated controllers is accomplished by dragging and dropping the desired processing object onto the appropriate user control.
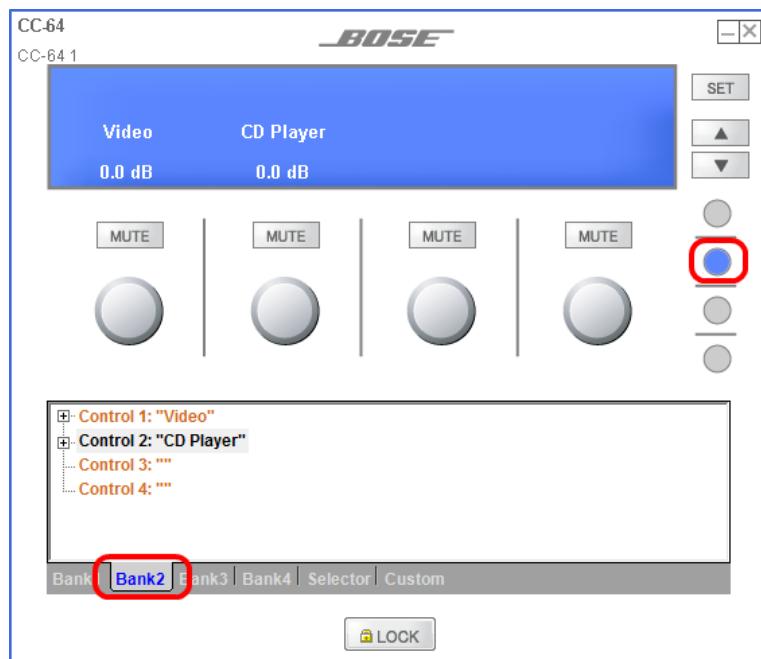
When you open the Smart Simulator, the controls for Bank1 are displayed in the programming tree by default.

You may assign functions to controls 1-4, which correspond to control knobs 1-4 once the Bank1 tab is selected, by dragging and dropping from ESP View onto the controls.
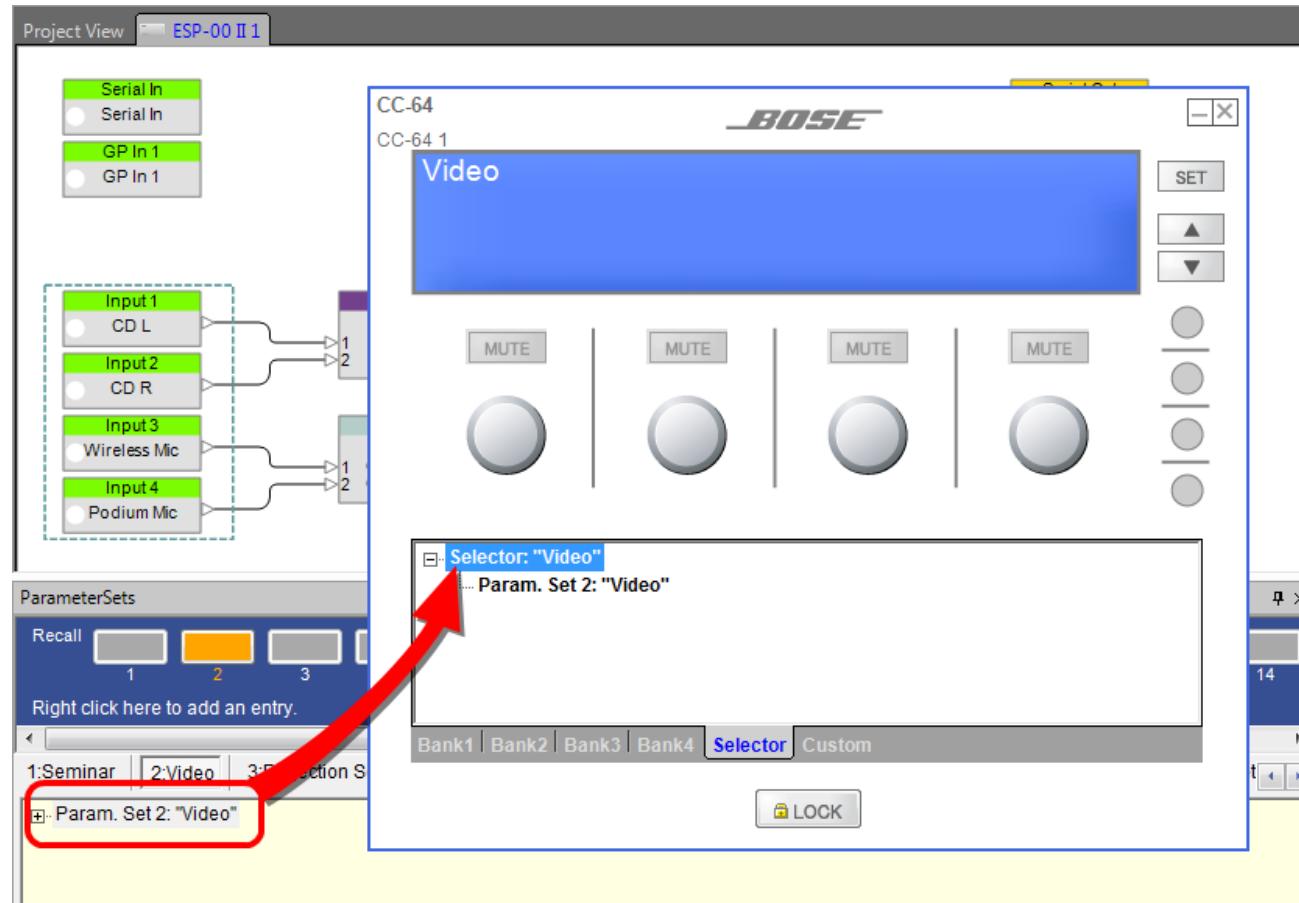
Dragging a sound processing block onto a Bank 1 control

To assign functions for the control knobs in Bank 2, select the Bank 2 tab at the bottom of the Smart Simulator window or press the Bank 2 selector button. Drag and drop functions onto the controls. The LCD display in the Smart Simulator shows what is displayed on the actual CC-64.
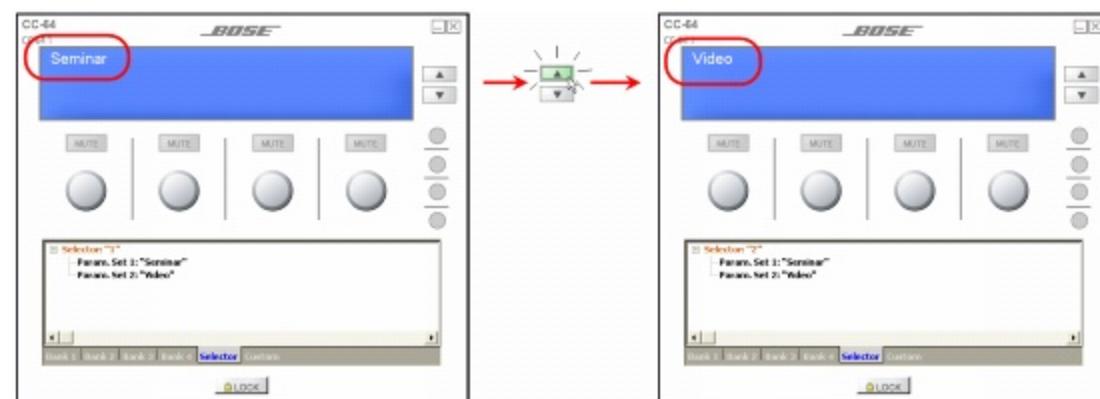
Assign functions to Bank 2

To assign functions to the Selector knob, choose the Selector tab at the bottom of the Smart Simulator window. Drag and drop a Selector sound processing block, or parameter set onto the Selector.
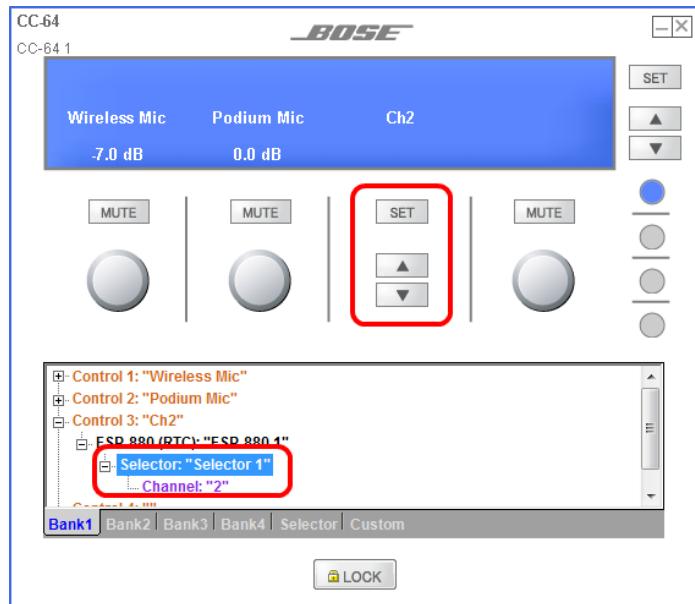

Dragging and dropping a parameter set into the Selector

Verify your programming by clicking on the Selector arrows in the Smart Simulator, which correspond to clockwise and counter-clockwise knob rotation. The display will switch between descriptions of any series of parameter sets assigned to the Selector.

*Testing the programming by switching between two parameter sets*
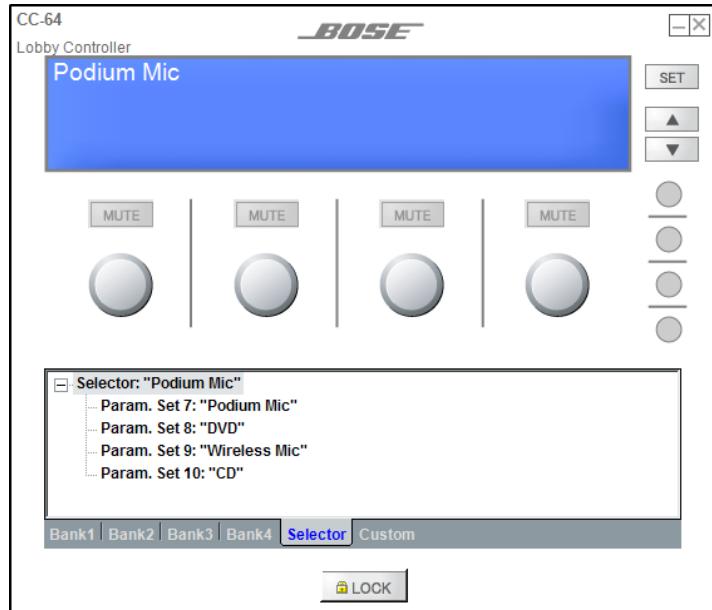
A control knob may also act as a selector. If you program a control knob to invoke parameter sets or control a selector block, the control will change to selector arrows in the Smart Simulator.

*A control knob programmed to operate a selector*
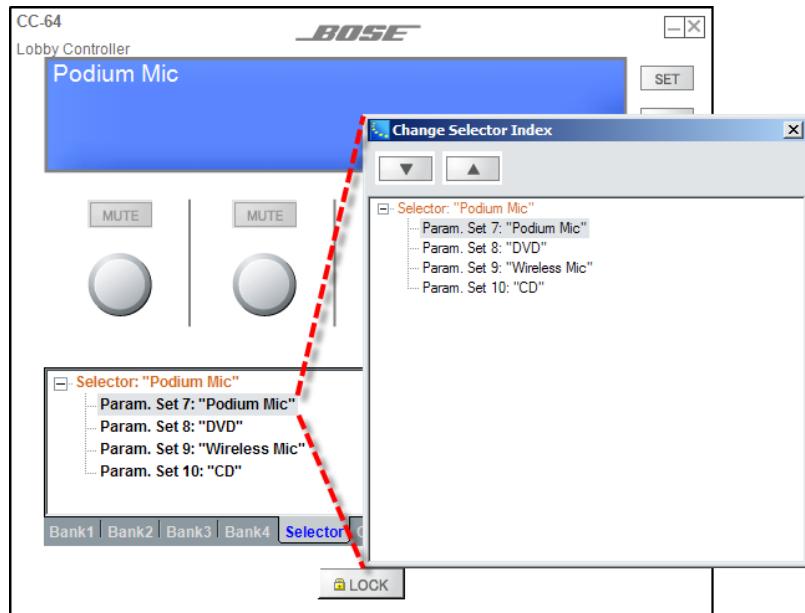
Changing the Selector Order

When a selector knob on the CC-64 is programmed with parameter sets, you have the option of changing the order in which the parameter sets appear. For example, you can program the CC-64 selector knob with four parameter sets as shown below:

*Programming the CC-64 selector knob with parameter sets*
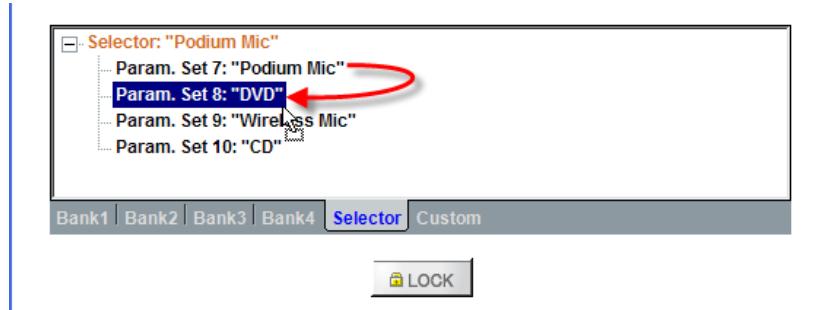
To change the order in which the parameter sets appear, double click on one of the parameter sets to open the Change Selector Index window.

*Double click a parameter set to open the Change Selector Index window*
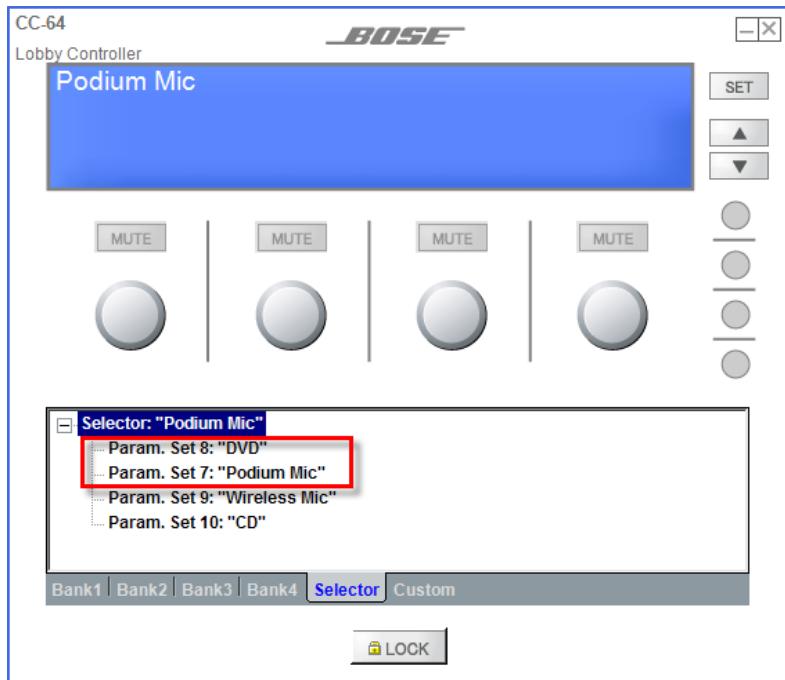
Use the arrow buttons at the top of the window to move the selected parameter set up or down in the list. In this window, you can select any of the parameter sets and use the arrows to change its position.

Another way to reorder the parameter sets is to drag and drop them within the CC-64 Smart Simulator window. For example, to move the "Podium Mic" parameter set to appear after the "DVD" parameter set, simply drag and drop the "Podium Mic" parameter set onto the "DVD" parameter set:
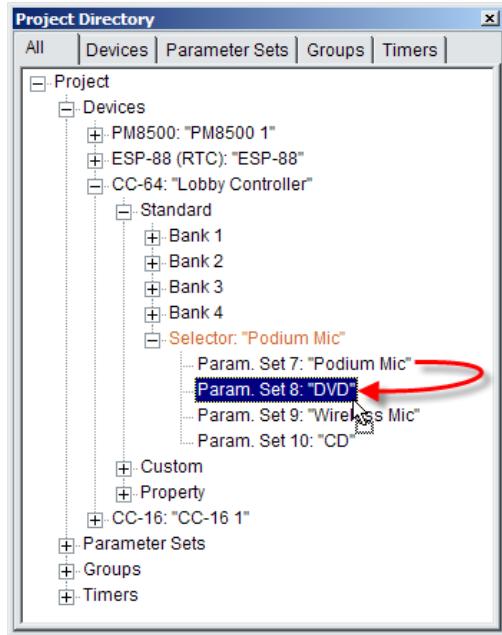

Dragging and dropping a parameter set to change the order

The list is reordered after the drag and drop operation.

Newly Reordered Selector List

This technique may also be used within the Project Directory window. Locate the CC-64 selector settings in the Project Directory window, then drag and drop to new positions to reorder the parameter sets within that list.

*Reorder List Items in the Project Directory Window*
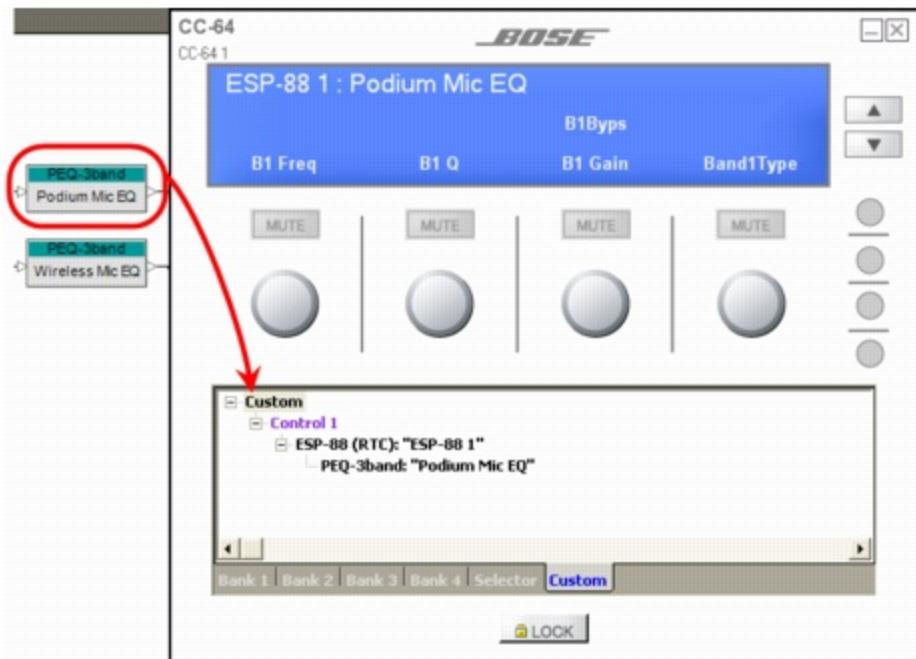
Custom Settings

The CC-64 supports a custom mode, whereby you can access settings for certain signal processing blocks such as EQ blocks, and crossover blocks by using a special button activation. You may program the CC-64 to control the

following signal processing block types in custom mode:

- Crossover
- Graphic EQ
- Tone control EQ
- Parametric EQ
- Delay
- Signal Generator
- Gain
- Input Block
- Output Block

To add signal processing blocks to the custom control, drag and drop one or more blocks listed above onto the Custom Tab of the CC-64 Programming Tree. The Smart Simulator displays the list of blocks assigned to custom control mode.


Dragging a Parametric EQ block onto a Custom control

Note: To access the Custom controls from the CC-64 hardware, press and hold the Selector knob for 5 seconds.

Locking the CC-64

When the CC-64 controller is locked, the user controls are disabled. This is very useful if you have multiple CC-64 controllers in your system and desire only one of the CC-64 controllers to be active at a time.
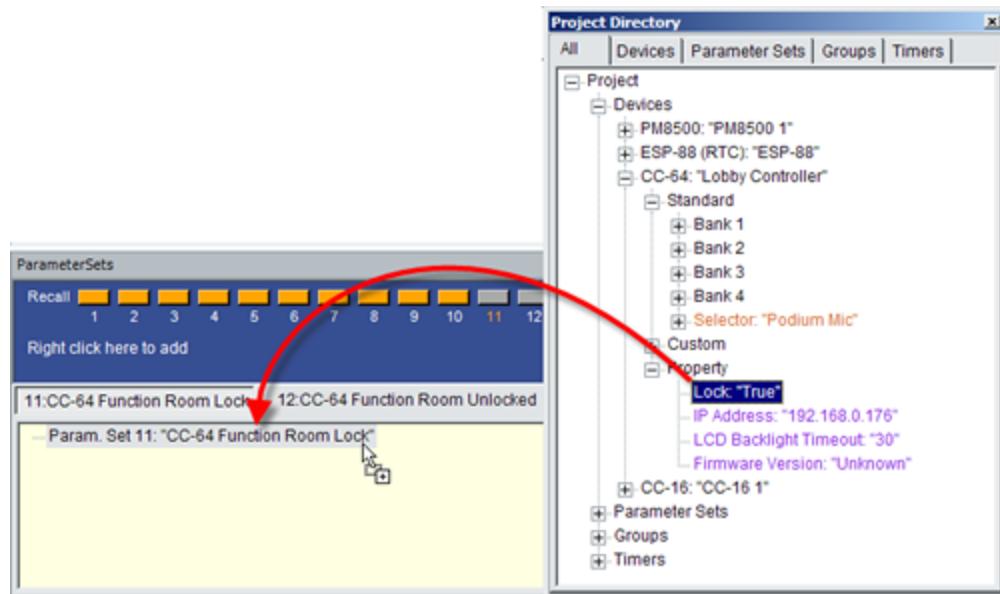
Consider a system configuration with two CC-64 controllers; one in a function room and another in a private office. During a crowded event in the function room, locking that control center prevents accidental change of system settings by unauthorized individuals. The master CC-64 located in the private office remains unlocked for performing system changes.

The lock/unlock status of a CC-64 must be stored in a parameter set. When this parameter set is invoked, the CC-64 is locked or unlocked according to the state stored in the chosen parameter set. To store the lock/unlock status in a parameter set, open the CC-64 Smart Simulator and set the lock state.
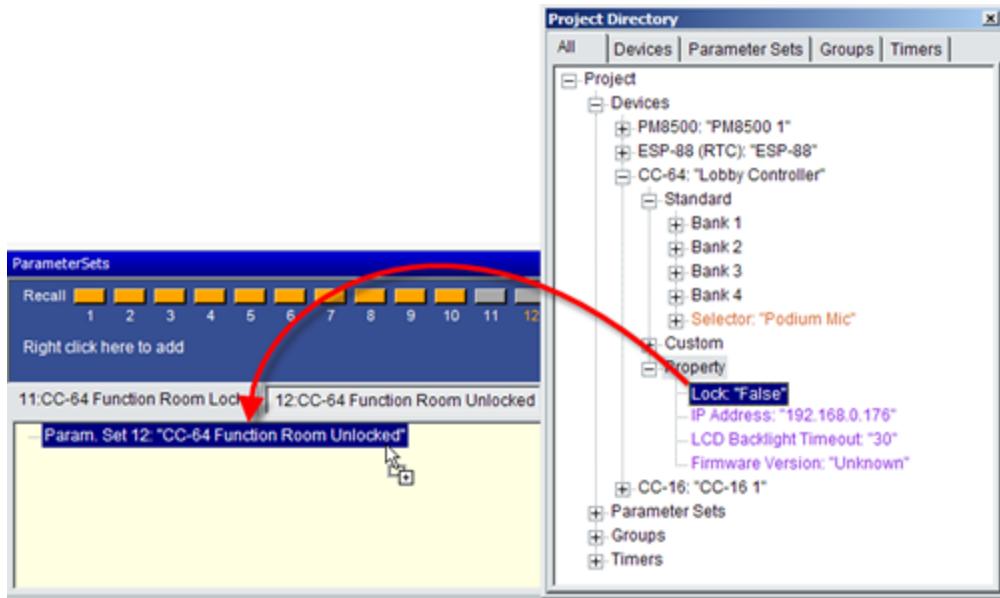

Enabling the CC-64 Lock

Next, open the Project Directory and locate the CC-64 Smart Simulator in the Device Tree. Expand the tree and drag only the Lock status property into a parameter set.

Creating a Lock CC-64 Parameter Set

Creating an Unlock CC-64 Parameter Set

To create a parameter set to unlock a locked panel, repeat this process by opening the Smart Simulator and setting the unlock state. Then drag the updated Project Directory lock status property into a new parameter set.

NOTE: Be careful not to add a parameter set to a CC-64 that locks itself unless you have another user control that can unlock the CC-64. Otherwise the user can become "locked out" of the system. Always add the unlock parameter set to an alternate user control (control panel, key switch connected to GPI, etc.) to ensure you can restore normal unlocked operation to the system.

Dynamic Control Programming with Parameter Sets

The CC-64 and CC-16 controllers can be programmed to control or invoke the following objects in ControlSpace Designer software:

- Gain blocks (including Input and Output blocks)
- Grouped Gain blocks
- Selector blocks
- Parameter sets
- Certain signal processing blocks, such as crossover and EQ, using custom settings in a CC-64

Once you have established your processing and control design, programming is accomplished by dragging and dropping the object to control onto the appropriate user control programming tree.
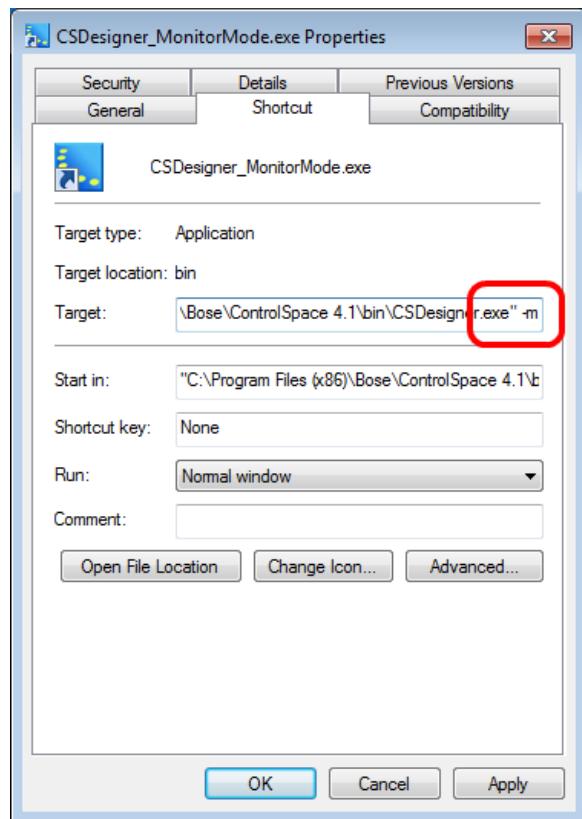
In ControlSpace Designer, you may also store different controller programming in separate parameter sets. When the parameter sets are invoked, the controller programming is changed.

Monitor Mode

ControlSpace® Designer™ software versions 3.0 and above provide support for running the application as a standalone system monitor. When configured for system monitor operation, all design and control programming functions are disabled and a system connection is automatically established at application launch. System monitor

mode provides the system owner with a convenient operational overview of all system devices, and virtual operation of system controls such as the CC-16 and CC-64 control centers.

Monitor mode is invoked by appending a command line parameter to the Target field of the application shortcut. To configure the application for monitor mode, create a shortcut for the ControlSpace Designer application or copy the existing shortcut for modification. Select the Properties item from the application shortcut's right-click menu. At the end of the application target location, add the parameter "[space]–m" outside the quotes as shown in the following example.
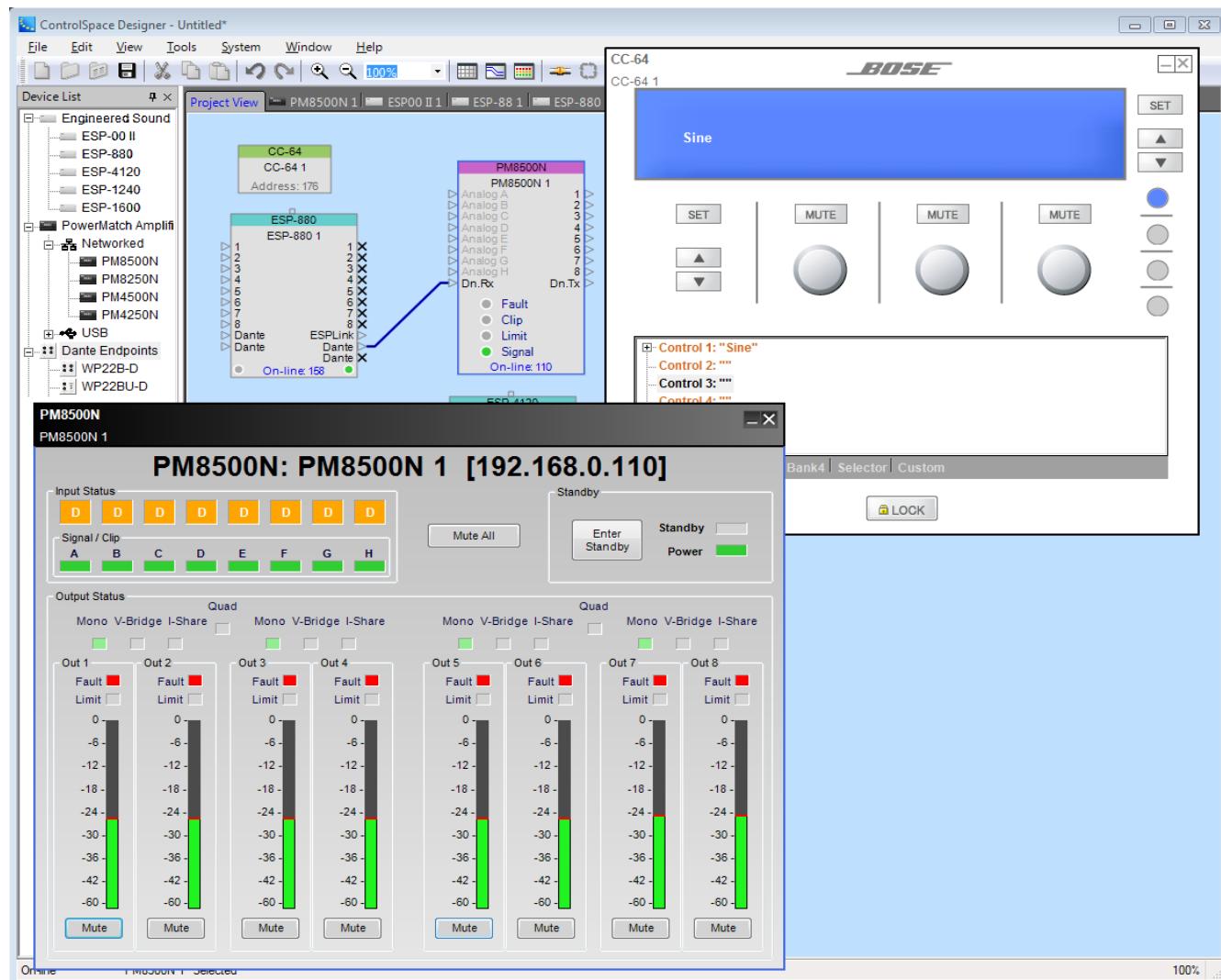

Creating a Monitor Mode Shortcut

Launch ControlSpace Designer from this modified shortcut to activate Monitor Mode.

Once Monitor Mode is active, all design functions are removed and the ControlSpace Designer application remains in Monitor Mode for all subsequent application launches using the modified shortcut.

When in Monitor Mode a system connection is automatically established when a design file is loaded and the running state of all system devices is retrieved and displayed within the ControlSpace Designer Project Tab.

*ControlSpace Designer software operating in Monitor Mode*

To exit monitor mode, close ControlSpace Designer software and restart the application using the standard short-cut.

Maintaining Your System

Protecting System Settings

Password Protection secures configuration files from unauthorized access by prompting the user to enter password each time the file is loaded by ControlSpace Designer. When a password protected configuration is uploaded to an ESP, it inherits the password protection stored in the configuration file.
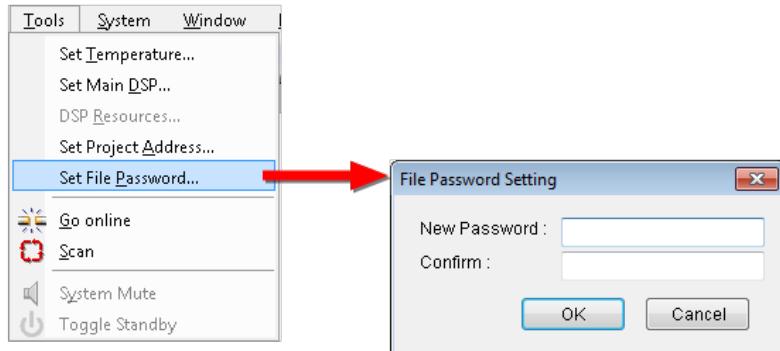
Password protected ESP systems will not accept new configuration uploads or downloads without supplying the password. Opening a password protected design file or attempting to go online with a protected ESP results in the following prompt.

Password Prompt

Protecting a Configuration (.csp) File

Password protection is accessed from the *Tools Menu* in the option entitled **Set File Password**.

Tools Menu - Set File Password

Options for the **File Password Setting** are as follows:

> **New Password:** – provides a text entry field to type a preferred password. The password may be any length word, phrase, or number combination.

> **Confirm:** - is a text entry field to verify the new password is entered as intended.

Note: Saving an unprotected back-up copy of the configuration file to a secure location before using the password protection option is highly recommended. It is possible to lock yourself out of your own configuration file if you lose or forget password.

Saving Protected Configuration (.csp) Files

Saving new designs to local storage after entering password settings will store a password-protection encryption key in the file. Thereafter, the design file may not be opened or changed without first entering this password.

Uploading Password-Protected Configuration (.csp) Files

When a password is stored in a design file, uploading that configuration to an ESP will protect the file within the hardware until that password is disabled. All subsequent file transfers to and from an ESP thereafter require the entry of this password.

Downloading Password-Protected Configuration (.csp) Files

If a password-protected configuration is stored within the ESP, you must enter the correct password when retrieving the configuration. Go online with an ESP, choose the *Download Configuration* option, and select either the *Running* or *Saved* options to access the password prompt.

If an incorrect password is entered, the software responds with an error. A valid password must be entered before proceeding.


Invalid Password Error

Uploading New Configuration (.csp) Files To Protected Systems

Once a password is enabled for a design file, uploading that configuration to an ESP by going **online** will protect the file within the hardware until the password is disabled. All subsequent file transfers to and from an ESP thereafter require the entry of this password.

Changing or Disabling Passwords in Protected Configurations

The password of a protected configuration file can be changed in either **online** or **offline** modes using the **Set File Password** command from the *Tools Menu*. Altering protected systems using the Set File Password sequence, results in a request to enter the old password before proceeding.

Old Password Prompt

After successfully entering the old password, new password entry occurs as shown above in Figure xx: Tools Menu - Set File Password. Entering blank information in the resulting Set File Password dialog removes password protection in the ESP and also in the design file if you choose to save it.

Retrieving System Configurations

Two functions are available within the ControlSpace® Designer™ software which allow you to retrieve the saved system settings without initiating a connection to the system.
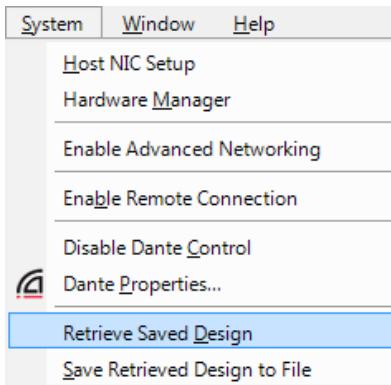
Retrieve Saved Design: Select this item to retrieve the project file without establishing a network connection to the system. Note that you must have an active network connection to enable this function.

Save Retrieved Design to File: Select this item to retrieve the project file without establishing a network connection to the system, and immediately save it as a file. Note that you must have an active network connection to enable this function.
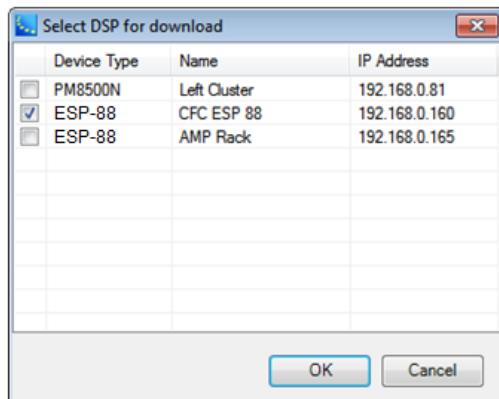
Retrieving a Saved Design

A copy of the original ControlSpace project file is stored within each signal processing device on the network, (ESP and PowerMatch). The project file contains the original system design and control programming, and represents the "power on" state of the system. To retrieve the saved system configuration use the following steps:

1. Select **Retrieve Saved Design** from the System Menu

2. From the list of available system devices, select the one from which you would like to retrieve the system configuration file and click **OK**.
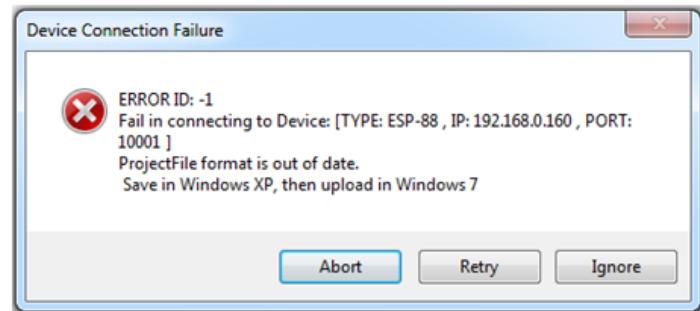

3. The system configuration is retrieved and displayed. At this point it is possible to either save the file directly to the PC, or initiate a connection to the system.
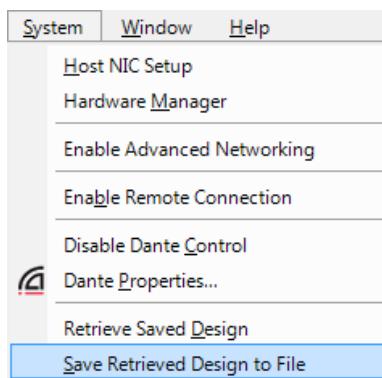
## Saving a Retrieved Configuration to File

When running on the Windows 7 operating system, ControlSpace Designer uses a new compression scheme to compress the ControlSpace project file before transferring it to the hardware. As a result, project files stored in hardware using a version of ControlSpace Designer older than v3.0 cannot be read without first saving them to local PC, and re-opening the file within ControlSpace Designer.
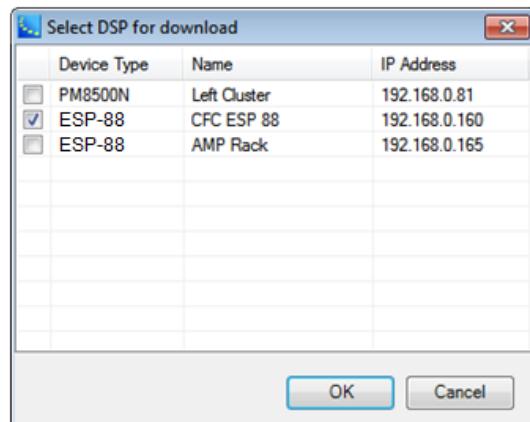
If when connecting to the system you receive the following error message, use the steps outlined below to retrieve the file and connect to the system.

Device Connection Failure

ERROR ID: -1
Fail in connecting to Device: [TYPE: ESP-88 , IP: 192.168.0.160 , PORT: 10001]
ProjectFile format is out of date.
Save in Windows XP, then upload in Windows 7

Abort | Retry | Ignore
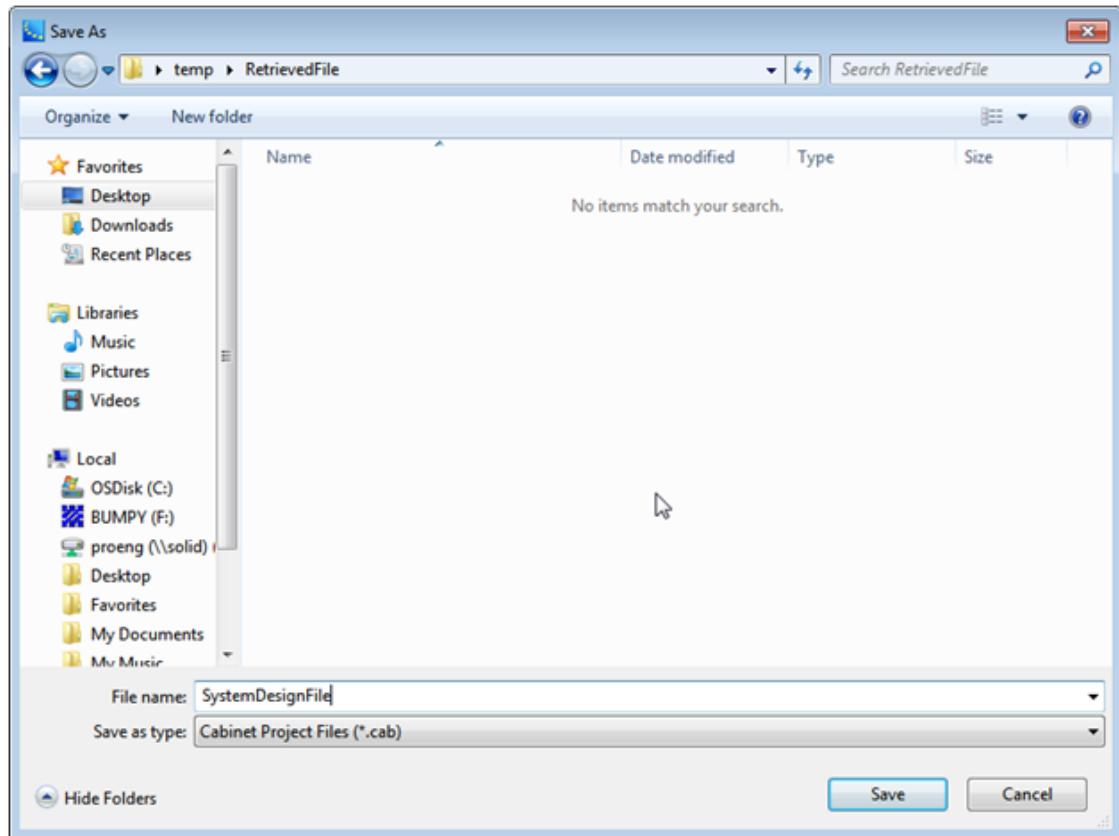
1. Select **Save Retrieved Design to File** from the System Menu
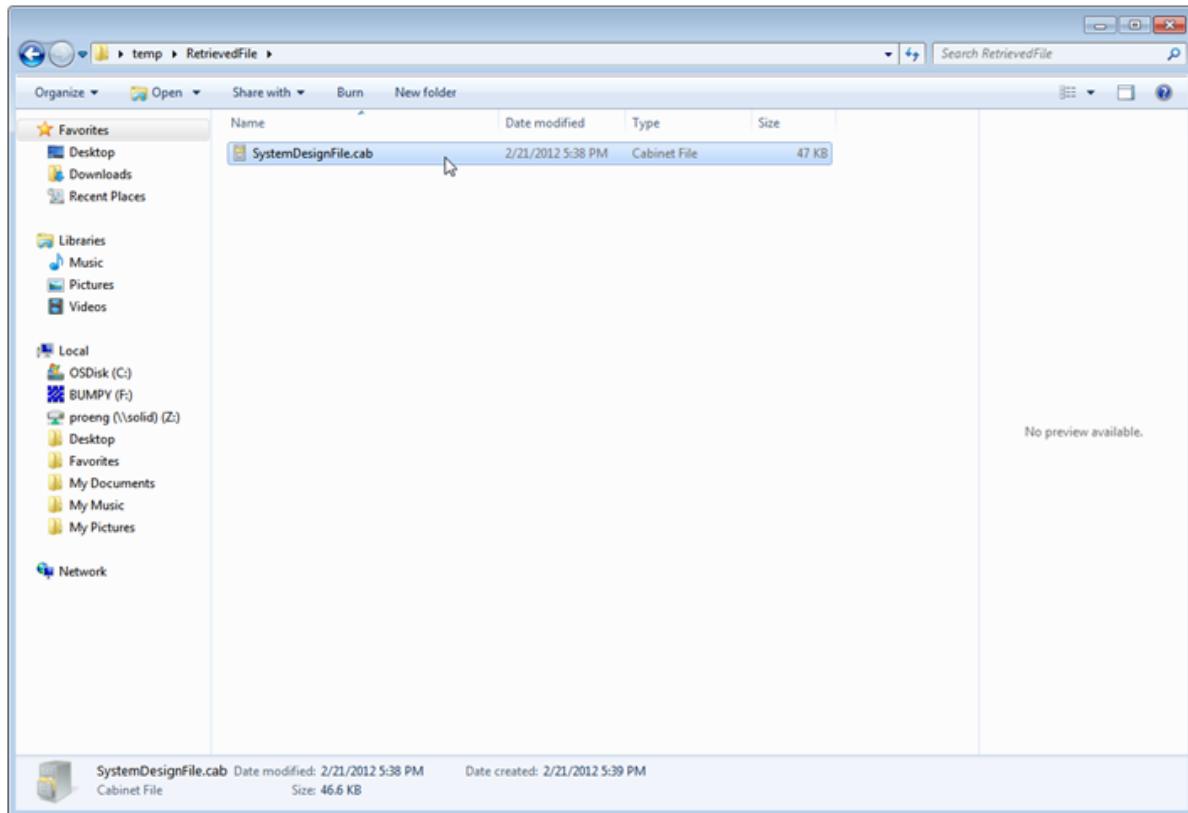
System | Window | Help

Host NIC Setup
Hardware Manager

Enable Advanced Networking

Enable Remote Connection

Disable Dante Control
Dante Properties...

Retrieve Saved Design
Save Retrieved Design to File

2. From the list of available system devices, select the one from which you would like to retrieve the system configuration file, and click **OK**.

Select DSP for download

| Device Type	Name	IP Address
PM8500N	Left Cluster	192.168.0.81
ESP-88	CFC ESP 88	192.168.0.160
ESP-88	AMP Rack	192.168.0.165

OK | Cancel

3. Select a location and name for the system design file and click **Save**.

4. Navigate to the file that was retrieved from the system and open it. The file is stored in a compressed file format (.cab) and can be opened directly from the Windows desktop.

5. Copy the file to the desktop, and rename it "SystemTransfer.csp." You will receive a warning asking if you wish to change the file extension. Click **OK**.

Once the file and its extension are changed, the file will become associated with the ControlSpace Designer software. You can now open the file from within ControlSpace Designer using the **File --> Open** command.

NOTE: For additional information on this topic, see the "Project File format is out of date" error on the ControlSpace User's Forum knowledge base.

Updating Firmware in Bose® Devices

The ControlSpace® engineered sound processor, PowerMatch® power amplifiers, CC-64 Control Center, and CC-16 Zone Controller interfaces require firmware to control their operation. Firmware is programming that is stored in Flash memory and is not erased when the power is turned off. On occasion, it is necessary to update this firmware to fix problems or improve features.

To update firmware, you will first need to get the new firmware file. The best method to do this is to simply download the latest version of ControlSpace® Designer™ software from the Bose Professional Systems Division web site.

Follow these steps to update the firmware:

1. Make sure all ControlSpace devices are powered on and connected using Ethernet cables to the port of the network switch.
2. Make sure the switch is connected to the DHCP router using an Ethernet cable.
3. Visit pro.Bose.com on the web and browse to the software downloads area of the ControlSpace Systems product area.
4. Locate the latest version of software and download the installation package to your local PC.
5. Launch ControlSpace Designer software version 4.3 or later.
6. Launch the Hardware Manager and go to the Firmware Update tab in the Device List.

Loudspeaker EQ updates

With the current release of ControlSpace® Designer™ you may also update the loudspeaker database independent of the ControlSpace Designer application. The necessary steps to update the loudspeaker equalization database are listed below:

Determining current loudspeaker EQ database version

From within the ControlSpace Designer application, access the Help menu and select *About*. The current loudspeaker database version is shown beneath the application version at the bottom of the *About* window.

Help About ControlSpace Designer Screen

If a newer version of Speaker Data is available, follow the steps below to update ControlSpace Designer.

Updating the Loudspeaker EQ Database

1. Download the latest version of the Bose loudspeaker equalization database for ControlSpace Designer software. The most recent database version is always available for download at pro.Bose.com.

2. Transfer the new *Speakers.xml* and *DeviceList.xml* files contained within the update archive to the ControlSpace designer application folder on your PC.

3. Locate the current ControlSpace Designer application directory. This is typically "C:\Program Files\Bose\ControlSpace Designer".

4. Open the \bin directory within the ControlSpace Designer application folder.

5. Rename the existing *Speakers.xml* file OldSpeakers.xml and *DeviceList.xml* to OldDeviceList.xml.

6. Transfer the new Speakers.xml and the DeviceList.xml files to the bin directory. Loudspeaker EQ Update v2 Page 2 of 2 July 19, 2010

7. Once the files have been copied, the new Bose loudspeaker EQs will be available within the ControlSpace Designer software when the application restarts.

8. Launch the Hardware Manager and go to the EQ Update tab in the Device List.

NOTES:

- **This method of updating the loudspeaker equalization database is used primarily to support the introduction of new loudspeaker products. However, in some cases a new loudspeaker equalization curve may be provided for an existing loudspeaker product.**

- **In cases where a new EQ is provided for an existing product it may be necessary to upgrade an existing installation or design to ensure compatibility with the latest equalization version.**

- **Any custom devices that have been added to ControlSpace Designer will be lost on transferring the new DeviceList.xml file. You will need to manually copy any custom devices from the OldDeviceList.xml into the new DeviceList.xml file.**

File Types

ControlSpace® Designer™ uses the following files types with specific extensions to define their function:

Extention	File Type
.csp	ControlSpace Designer project files (raw xml)
.exe	Executable program files (binary)
.frm	ESP & PowerMatch firmware files (binary)
.hex	CC-16 firmware files (binary)
.mot	CC-64 firmware files (binary)
.peq	Parametric Equalization files (raw xml)
.seq	Speaker Equalization files (formatted xml)
.xml	Device List and Loudspeaker Database files (formatted xml)

Application Examples

City Council Chamber

As part of a Bose ControlSpace® system design, the Automatic Microphone Mixer provides the perfect solution for multi-microphone public space installations. This application example describes its use in a typical city council chamber.

Created using the Bose® ControlSpace Designer™ software, Figure 1 provides an overview of project elements. In this figure, microphones and other input devices are shown on the left, while loudspeakers and other output devices are shown on the right. User interfaces appear at the top and at the heart of the system is the ControlSpace ESP-00 II engineered sound processor.
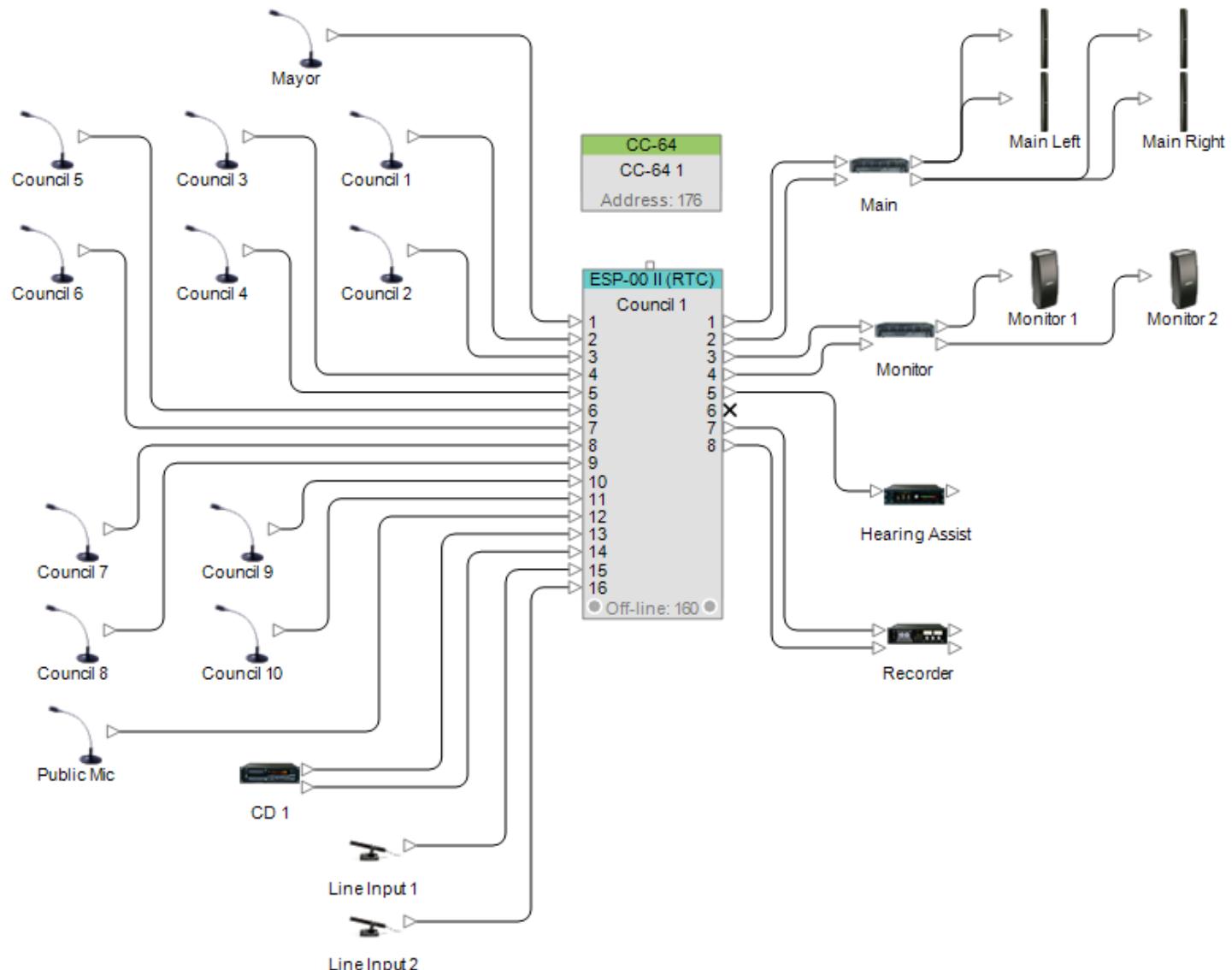
Figure 1: City Council Chamber project elements

In this design, input signals managed by the automatic microphone mixer include those from the Mayor's microphone, ten council member microphones, and a public podium microphone (channels 1-12). While all microphones remain "active" during normal operation, unwanted speech or noise will not be reproduced by the system because the automatic microphone mixer will only allow the signal to pass once it exceeds a predefined volume.

This is accomplished by using the following DSP processing configuration:

Figure 2: Digital Signal Processing configuration

Input Processing

The input processing section comprises:

- Signal conditioning
- Automatic microphone mixing
- Main mixing and routing.

Signal conditioning includes independent gain and equalization for each input channel. This streamlines system programming, allowing separate configurations for the user-assigned gain and system gain in order to optimize signal to noise throughout the system. Each channel also incorporates a 3-band parametric EQ.

Figure 3: Independent input gain (volume) and equalization for each microphone

The **automatic microphone mixer** manages twelve system microphones. Processing in this section includes automatic mixing combined with compressor/limiter functions to deliver a consistent volume level. This design incorporates a parametric EQ configured as a band-pass filter (250Hz-4kHz), driving the side-chain input of the compressor and keeping the compressor responsive to the speech signal only, rather than bass frequencies or noise from handling the active microphone. The automatic microphone mixing function spans two signal processing blocks with the Mayor's microphone connected to input number one on both, thus ensuring the highest system priority for that microphone.
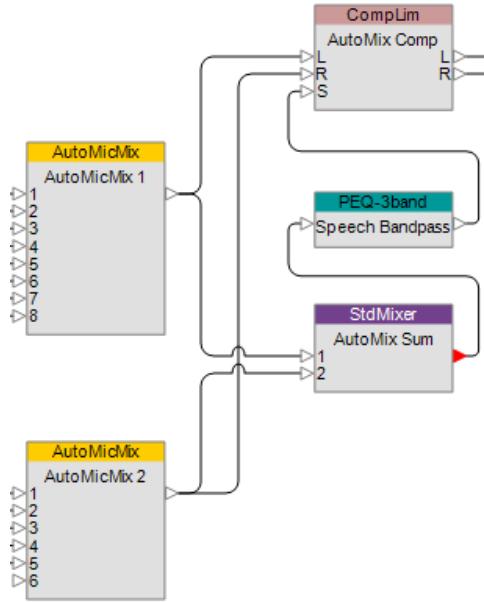
Figure 4: Automatic microphone mixer processing section

The **main mixing and routing** section handles the mixing and routing of all system inputs to the various zones:
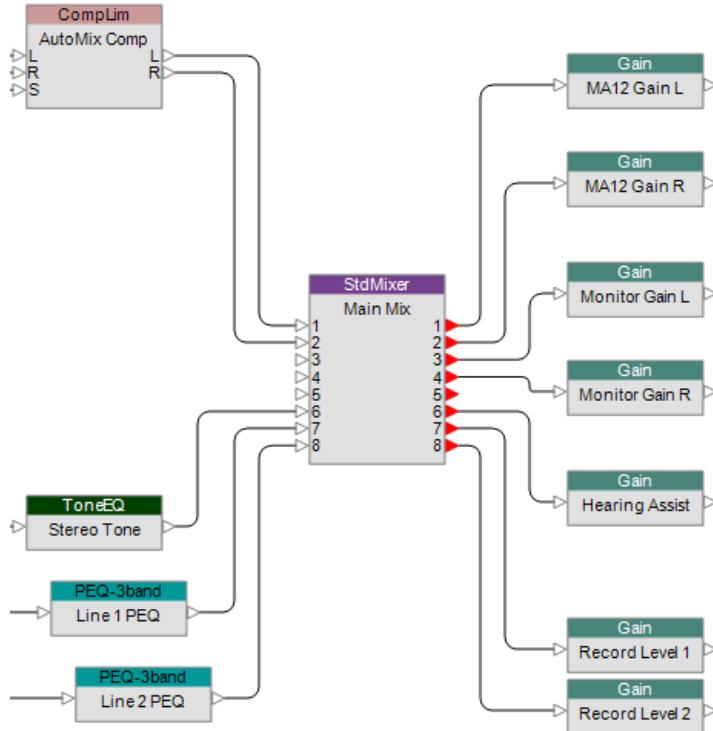
Figure 5: The main mixing and routing section

Output Processing

The ControlSpace Automatic Microphone Mixer output processing comprises zone gain, zone EQ, loudspeaker EQ, and protection limiters for each zone.
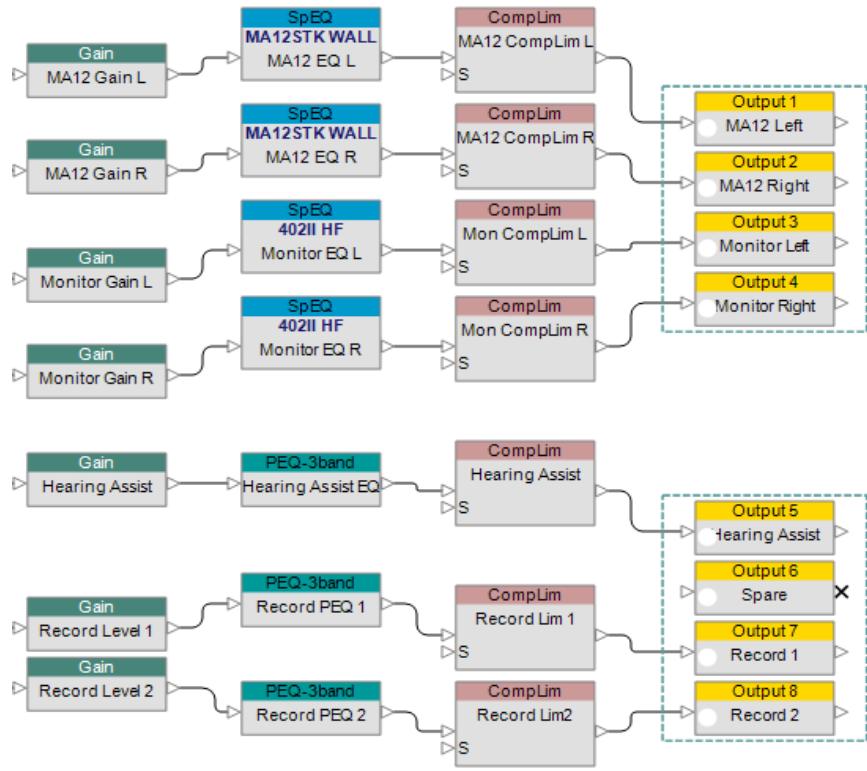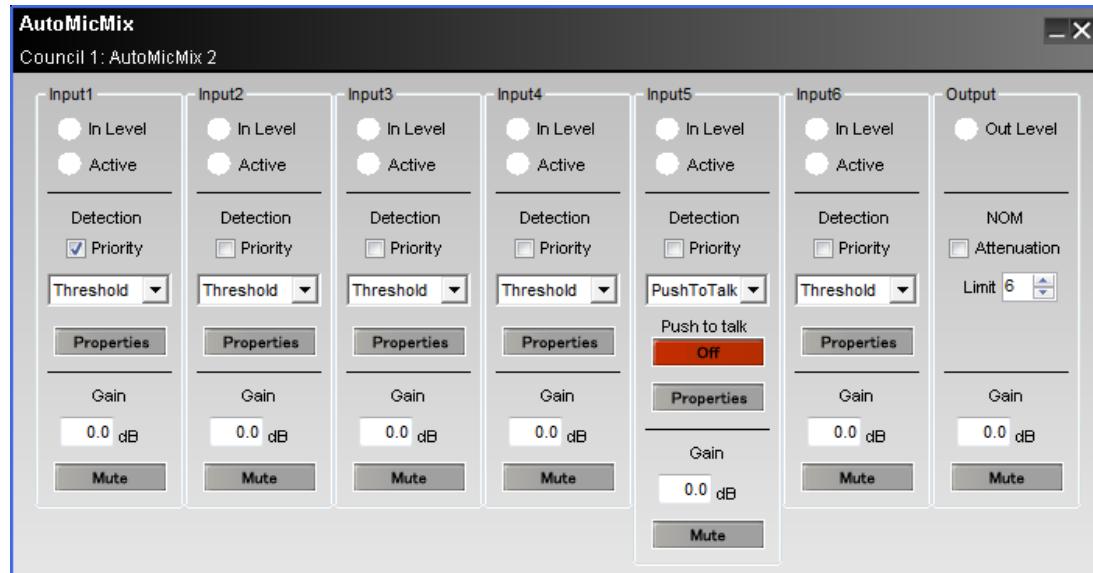
Figure 6: Output processing section

Microphone Mixers

A threshold detection method is used with all microphones except the public podium. This allows microphone signals above a certain level to pass to the output stage of the mixer. During system commissioning, we will configure all input gain settings.
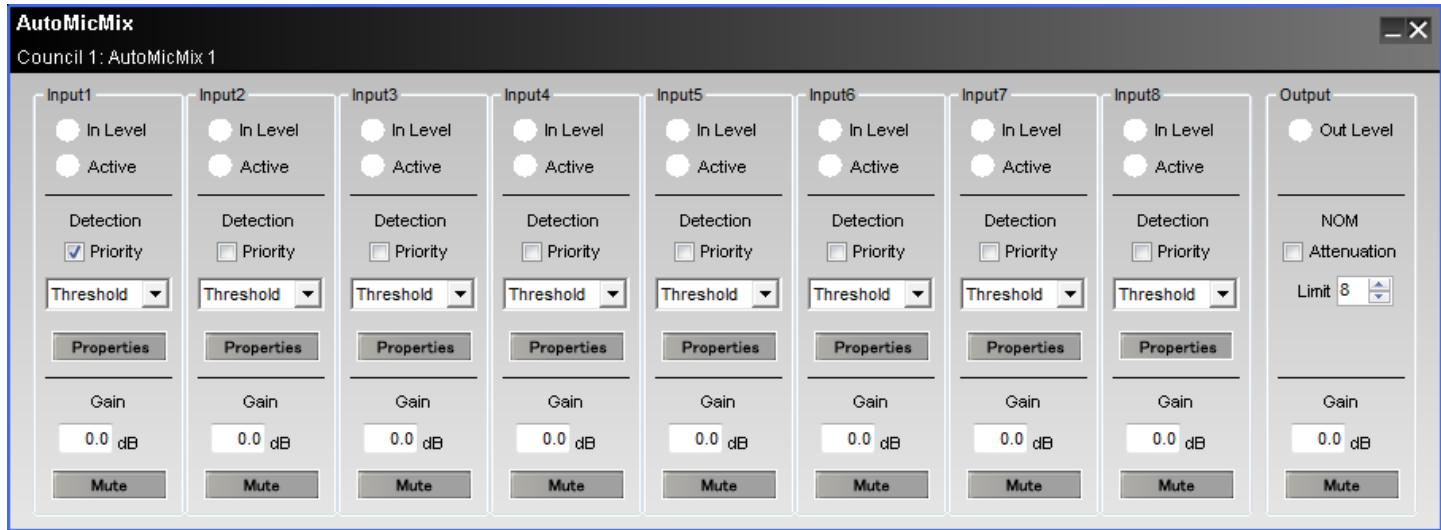
Figure 7: Automatic microphone mixing settings

"Push-to-Talk" detection is used with the public podium microphone. Bose Professional System installers place a sensor pad underneath the carpet behind the podium. Once someone steps on this pad, a contact closure is provided to the ControlSpace ESP General Purpose Input 1, thus activating the microphone.
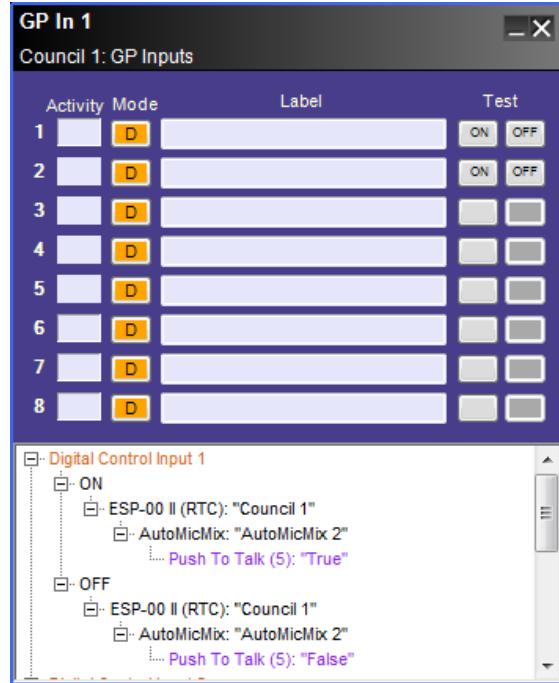
Figure 8: "Push-to-Talk" detection on the public podium microphone

Override Provisions

The system includes a master override provision called "Mayor Mode." Pressing a push button switch at the Mayor's position will mute all other microphone and input sources. The inverse of "Mayor Mode" is "Normal Mode" which is restored when the button is release. This switch connects to General Purpose Input 2.
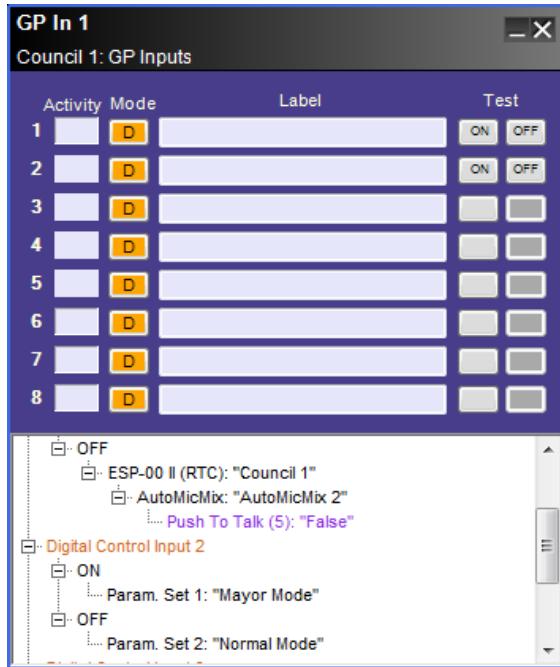
Figure 9: Mayor Mode control

Finally, we use an output gain attenuation function called "number of open microphones" (NOM) for this system. When multiple microphones are active, the output gain will be reduced by 10*LOG(NOM). The following graph shows the amount of attenuation applied for a given number of open microphones:
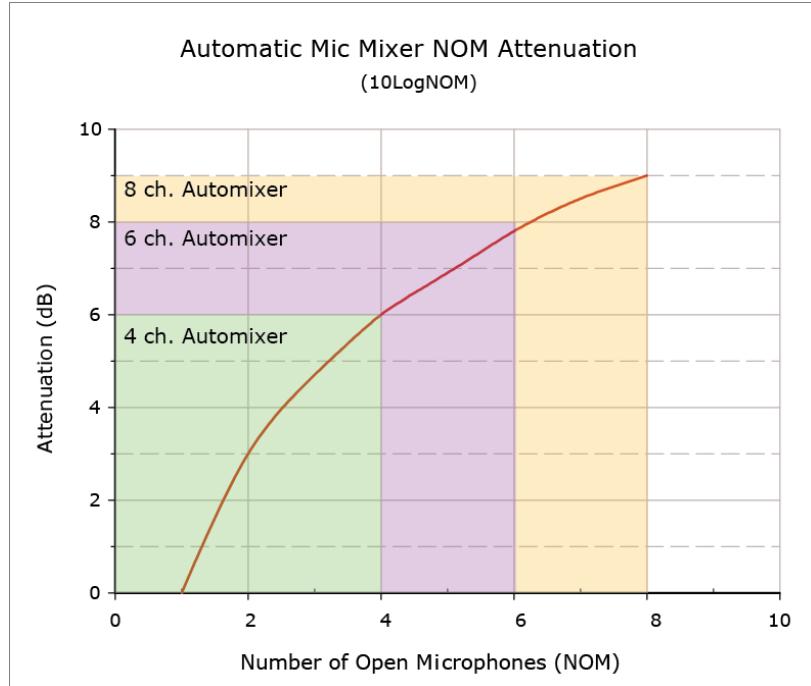

Figure 10: Number of Open Microphones (NOM) attenuation

House of Worship

As part of a Bose® ControlSpace® system design, the Automatic Microphone Mixer provides an elegant solution for multi-microphone installations. This application example describes its use in a typical house of worship.

Created using the Bose ControlSpace Designer software, Figure 1 provides an overview of project elements. In this figure, microphones and other input devices are shown on the left, while loudspeakers and other output devices are shown on the right. User interfaces appear at the top and at the heart of the system is the ControlSpace ESP-00 II engineered sound processor.
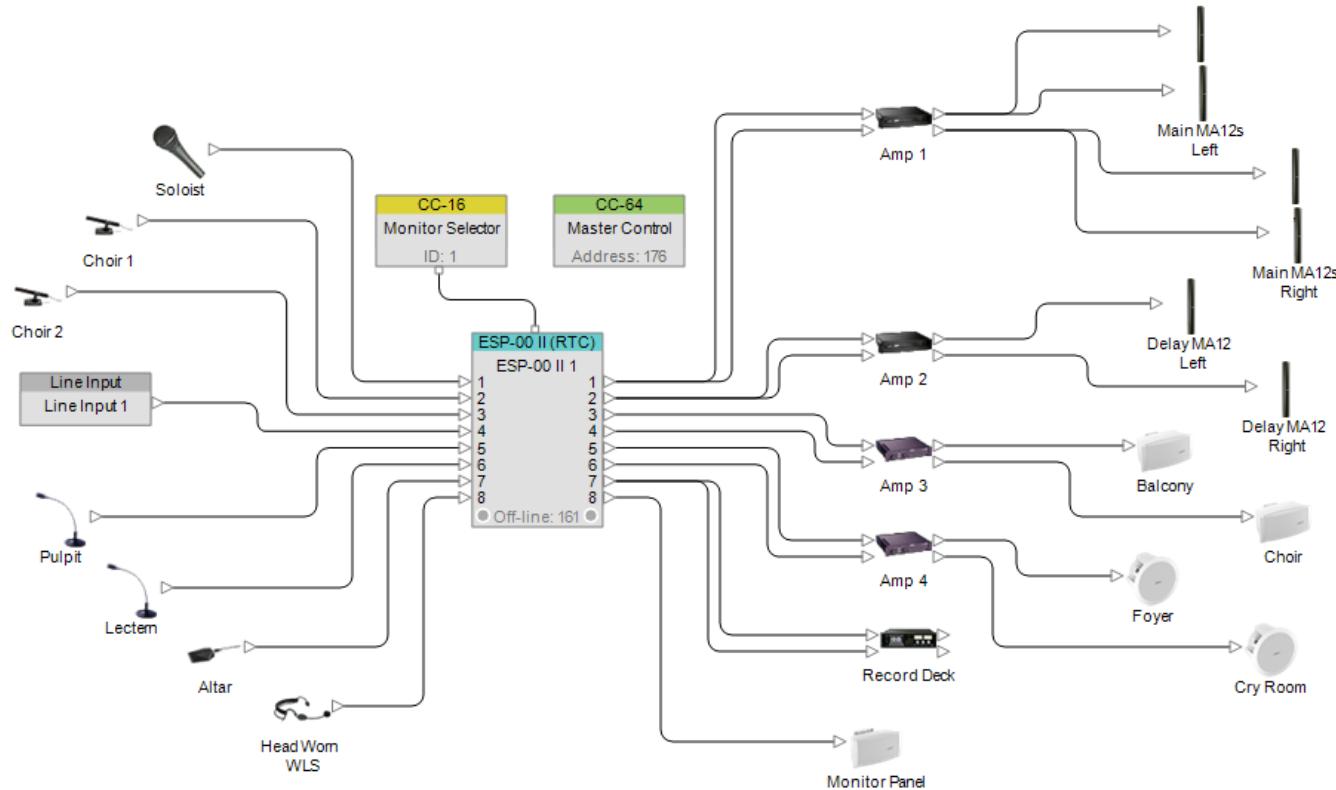
Figure 1: House of worship project elements

In this design, input signals managed by the automatic microphone mixer include those from the pulpit, lectern, altar, and wireless microphones (channels 4-8). While all microphones remain "active" during normal operation, unwanted speech or noise will not be reproduced by the system because the automatic microphone mixer will only allow the signal to pass once it exceeds a predefined volume.

This is accomplished by using the following DSP processing configuration:

Figure 2: Digital Signal Processing configuration

Input Processing

The input processing section comprises:

- Signal conditioning
- Automatic microphone mixing
- Main mixing and routing.

Signal conditioning includes independent gain and equalization for each input channel. This streamlines system programming, allowing separate configurations for the user-assigned gain and system gain in order to optimize signal to noise throughout the system. Each channel also incorporates a 3-band parametric EQ.


Figure 3: Independent input gain (volume) and equalization for each microphone

The **automatic microphone mixer** manages four system microphones. Processing in this section includes automatic mixing combined with compressor/limiter functions to deliver a consistent volume level. This design

incorporates a parametric EQ configured as a band-pass filter (250Hz-2kHz), driving the side-chain input of the compressor and keeping it responsive to the speech signal only, rather than bass frequencies or noise from handling the active microphone.
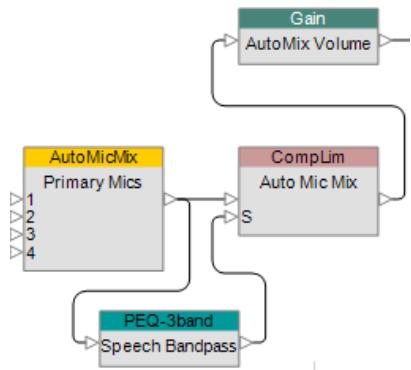

Figure 4: Automatic microphone mixer processing section

The **main mixing and routing** section handles the mixing and routing of all system inputs to the various zones:
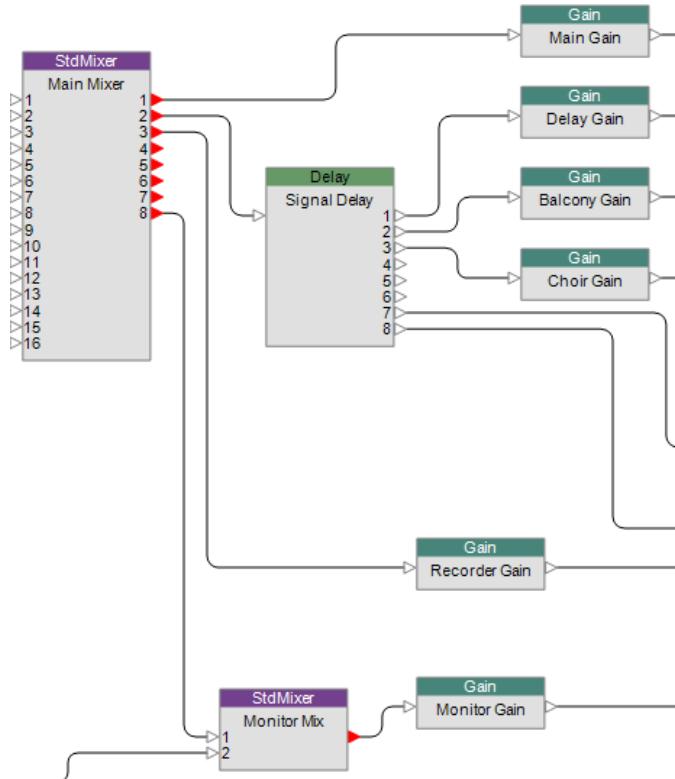

Figure 5: The main mixer and routing section

Output Processing

The ControlSpace Automatic Microphone Mixer output processing comprises signal alignment delay, zone gain, zone EQ, loudspeaker EQ, and protection limiters for each zone.
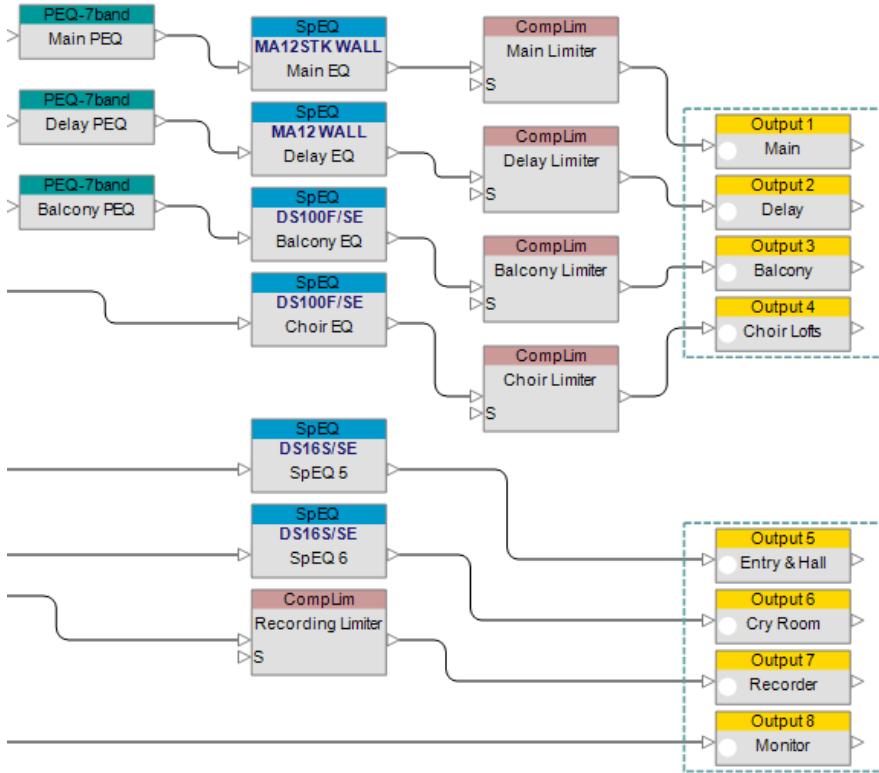
Figure 6: Output processing section

Microphone Mixers

A threshold detection method is used with pulpit, altar and wireless microphones (channels 1, 3 and 4). This allows microphone signals above a certain level to pass to the output stage of the mixer. During system commissioning, we will configure all input gain settings.
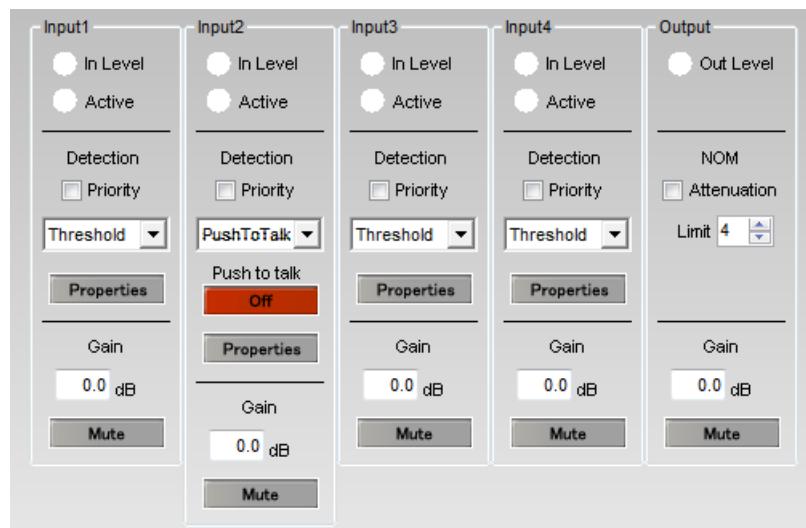

Figure 7: Automatic microphone mixing settings

"Push-to-Talk" detection is used with the lectern microphone. Bose Professional System installers place a sensor pad underneath the carpet behind the podium. Once someone steps on this pad, a contact closure is provided to the ControlSpace ESP General Purpose Input 1, thus activating the microphone.
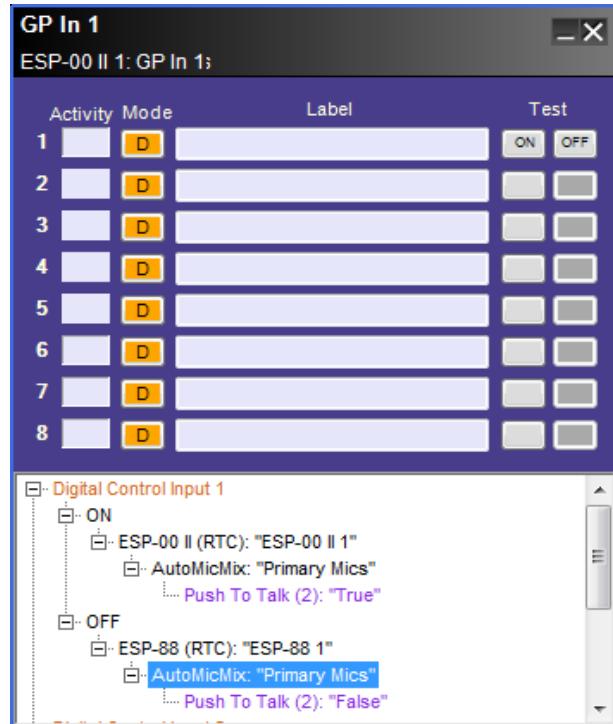

Figure 8: "Push-to-Talk" detection on the public podium microphone

Surround Sound Decoder

The Bose® ControlSpace® Surround Sound Card offers new opportunities for integration of surround sound systems into commercial spaces. The flexibility of ControlSpace systems and the enhanced listening experience afforded by a surround sound system, makes for an impactful product solution. This application note illustrates basic surround sound system design principles and the implementation of a multi-purpose facility design, within a ControlSpace system.

The following concepts are explored:

- Surround sound system types
- Positioning surround sound loudspeakers
- Implementing a surround sound system
- Multi-purpose surround system design example

Background

We are more accustomed to the immersive listening experience provided by surround sound systems than ever before. They are used in many different types of venues from home theaters to movie theaters. These venues range in size from small spaces to large rooms, and the use of surround sound systems runs the gamut from multi-purpose implementations to highly specialized facilities. Figure 1 illustrates the four primary quadrants of surround sound venue implementation today.
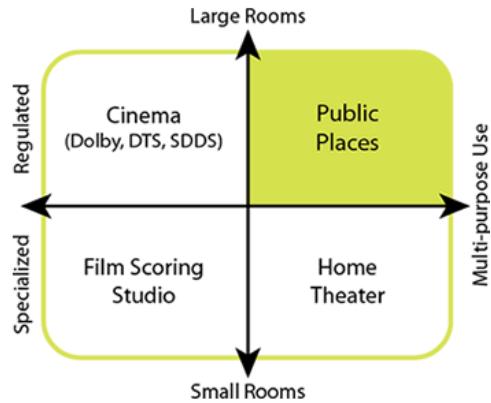
Figure 1: Typical surround sound system venues

Surround sound system types

The markets targeted by the new ControlSpace Surround Sound Card fit within the upper right-hand quadrant of this graph. Medium to large sized venues with multi-purpose needs are in the sweet spot for surround sound systems managed by ControlSpace. Knowing this, let's take a look at the basic surround sound configurations in today's marketplace.

Surround sound systems are referenced by the number of output channels they produce. The three most common today are named 5.1, 6.1, and 7.1. The first number of this classification indicates the number of full range signals in use. The .1 represents the number of Low Frequency Effect (LFE) channels in operation. The LFE output channel may also receive low frequency information from any of the full range channels when bass management is in effect. The loudspeaker arrangements associated with each of these surround sound system types are shown in Figure 2.
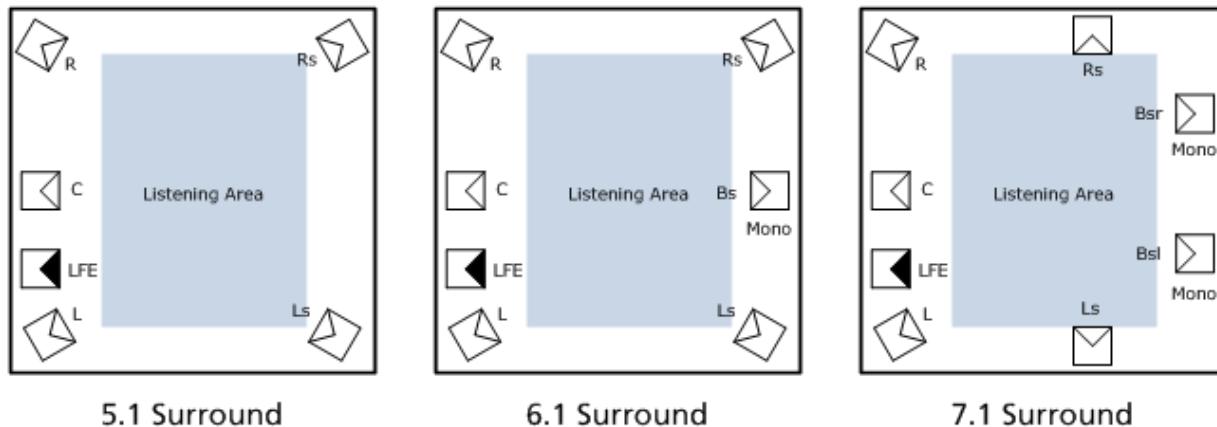

Figure 2: Surround sound system configurations

Positioning surround sound loudspeakers

When designing loudspeaker systems to reinforce a specific surround sound configuration, the following recommendations will help you position each device appropriately. Front channel loudspeakers (Left, Center, Right)

should be positioned behind acoustically transparent projection screens and at a height 65% of the total screen height from its base.
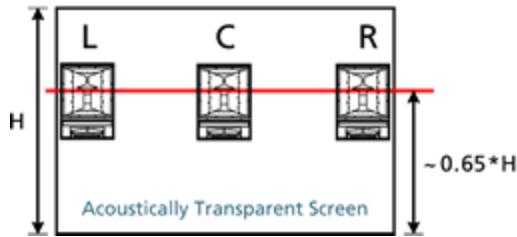

*Figure 3: Loudspeakers behind screen*
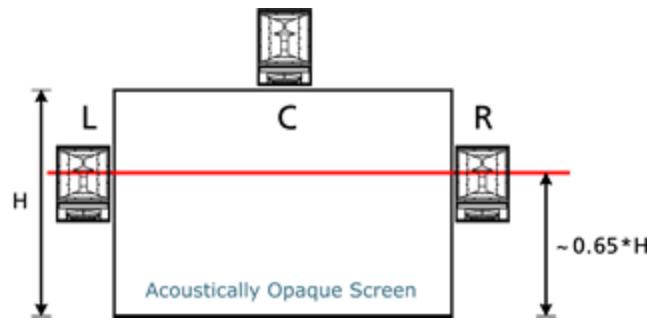
Figure 4: Loudspeakers around screen

When the projection screen is opaque, the same height rule applies to left and right loudspeakers, but they are oriented outside the perimeter of the screen to a location which will not obscure the on-screen image. The center channel loudspeaker is positioned above the screen in cases like this.

A Low Frequency Effects (LFE) loudspeaker should always be located near the front channel loudspeakers. Moving this loudspeaker away from the other front loudspeakers will reduce its impact and effectiveness during music and movie playback.
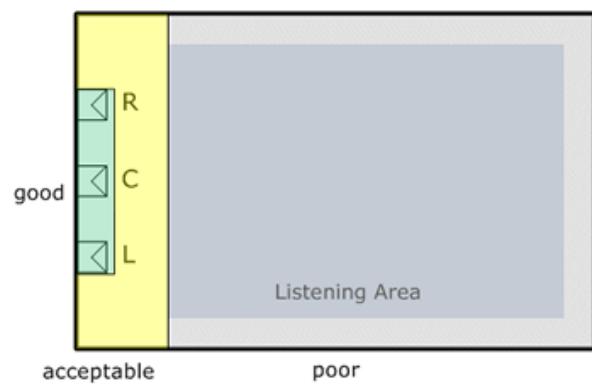

Figure 5: LFE performance area

The optimum LFE position is between the left and right loudspeakers and off axis from the center of the room. This will help to maximize low frequency energy throughout the listening space.
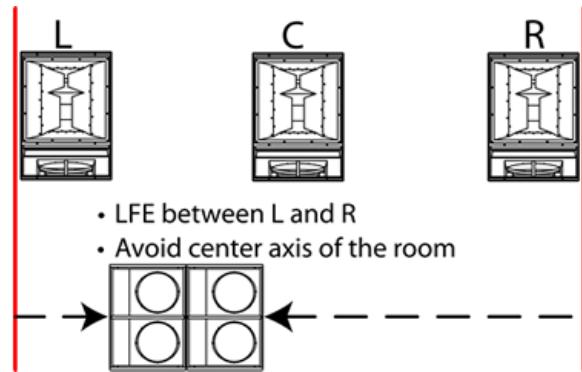

Figure 6: Recommended LFE positioning

Bi-amped loudspeakers are recommended for use with the front channels (L, C, R). The crossover range between the front channels and the LFE loudspeakers should be between 80 and 100 Hz. Each of the surround channel loudspeakers should be full range devices.

Using surround sound loudspeakers that have wider than traditional horizontal coverage, or Articulated Array® technology can enlarge the sweet spot, providing a better surround experience to a larger number of listeners. This becomes a critical factor in system designs for multi-purpose facilities using surround sound.

Bose® Panaray® 402®, Panaray 302™A, and FreeSpace® DS100SE loudspeakers all use Articulated Array technology and make excellent surround sound devices.

In the Multi-purpose surround system design example which we will explore in the following pages, a 7.1 system design option is chosen for maximum flexibility. The positioning of the loudspeakers supporting the surround channels also have rules of thumb to promote a quality experience.

In 7.1 surround systems, the right and left surround loudspeakers (Ls & Rs), which mount on the side walls, should be positioned at 66% of the distance from the projection screen to the back of the room. The back surround loudspeakers (Bsl & Bsr) mount on the back wall of the listening space and are located 25% of the total room width from the back corners.
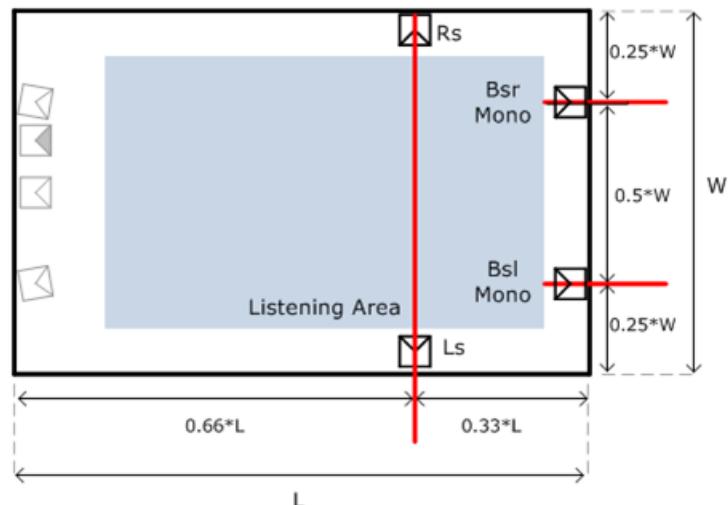
Figure 7: Surround loudspeaker location rules of thumb

Large rooms often require a signal delay applied to rear surround channels to ensure localization to the projected image on screen. Figure 8 illustrates this delay zone with a dashed red box in the rear one-third of the listening space.
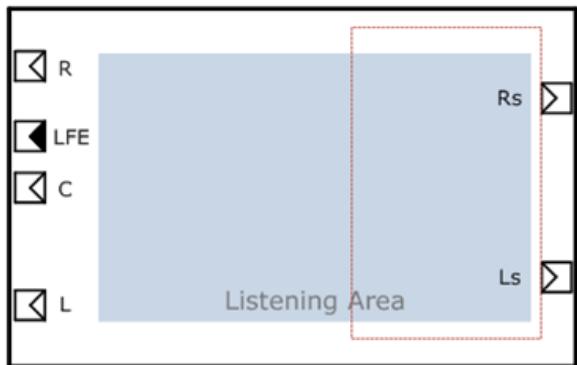

Figure 8: Surround sound audio delay for video zone

Note: Surround zone delays should only be implemented during playback of video sources (movies). If DVD-Audio program material is active, this signal delay should be disabled. ControlSpace® systems support dynamic configuration of delays and all manner of related system adjustments that are warranted as the input program material changes its content.

Signal Processing Considerations

The use of Compressor/Limiter processing blocks within ControlSpace systems is strongly recommended to protect loudspeaker drivers. It is normal for action movies to dramatically vary the loudness of passages to achieve a desired effect. Without compression components in the signal chain, extremely loud passages can easily damage loudspeakers in short order.

The DSP power and flexibility of ControlSpace systems will help you dynamically manage signal delay to surround channels as digital program content changes, and when multi-purpose systems vary modes of operation, ControlSpace will adapt its configuration in real time, according to your design.

Please see our multi-purpose surround sound application note for methods to implement these concepts in a system configuration of a Bose® ControlSpace® ESP engineered sound processor.

Youth Multi-Purpose Facility

As part of a Bose® ControlSpace® system design, the Surround Sound Card provides new options for multi-purpose installations. This application note describes its use in a youth multi-purpose facility.

Figure 1 below, created using the Bose ControlSpace Designer software, provides an overview of project elements. In this figure, media players, microphones and other input devices are shown on the left, while loudspeakers and other output devices are shown on the right. The master user interface appears at the top of this diagram and at the heart of the system is the ControlSpace ESP-00 II engineered sound processor.
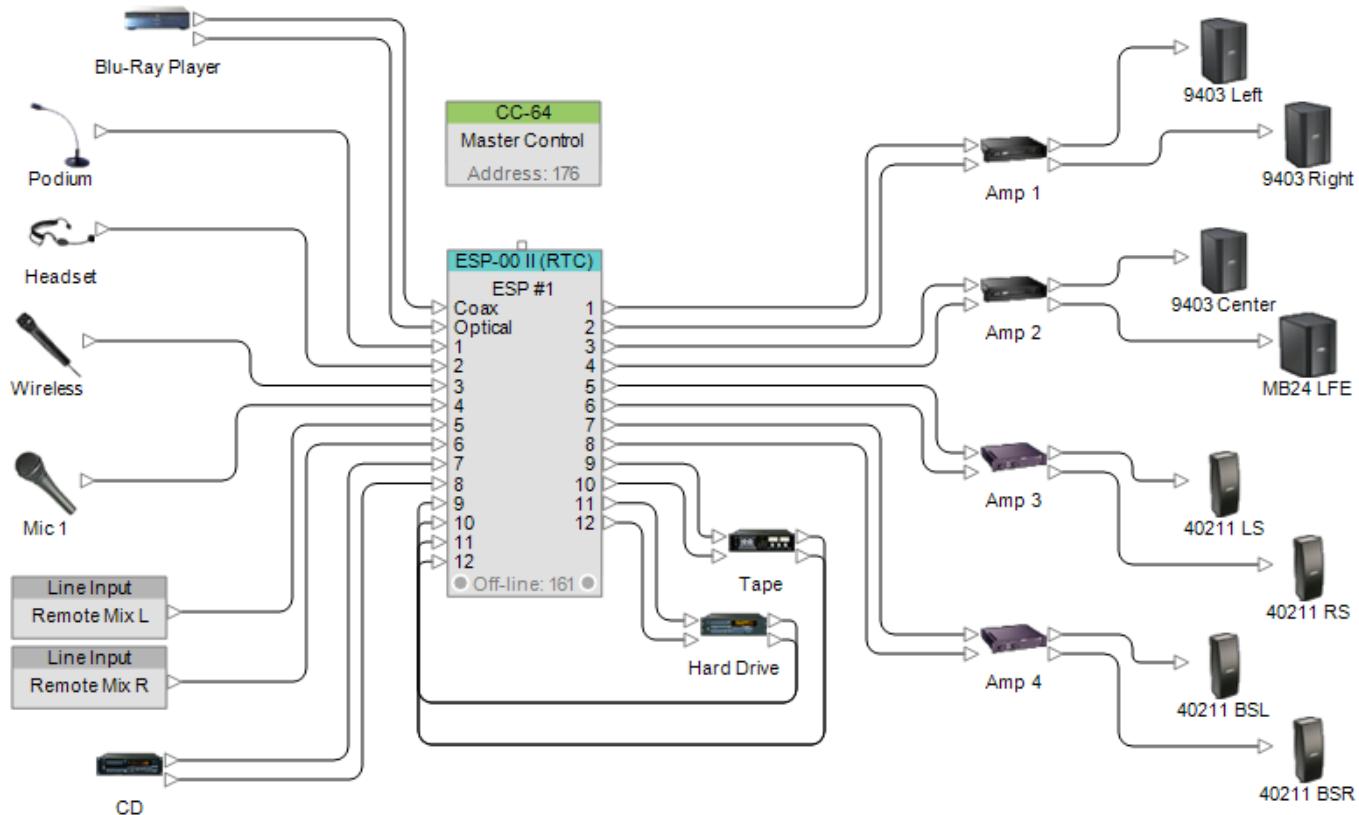
Figure 1: Youth Multipurpose Facility project elements

This system provides traditional sound reinforcement functions such as speech and music playback. It also adapts to deliver an immersive surround sound experience with a loudspeaker design that supports eight total output channels of audio. For this design, we use the following DSP processing configuration:
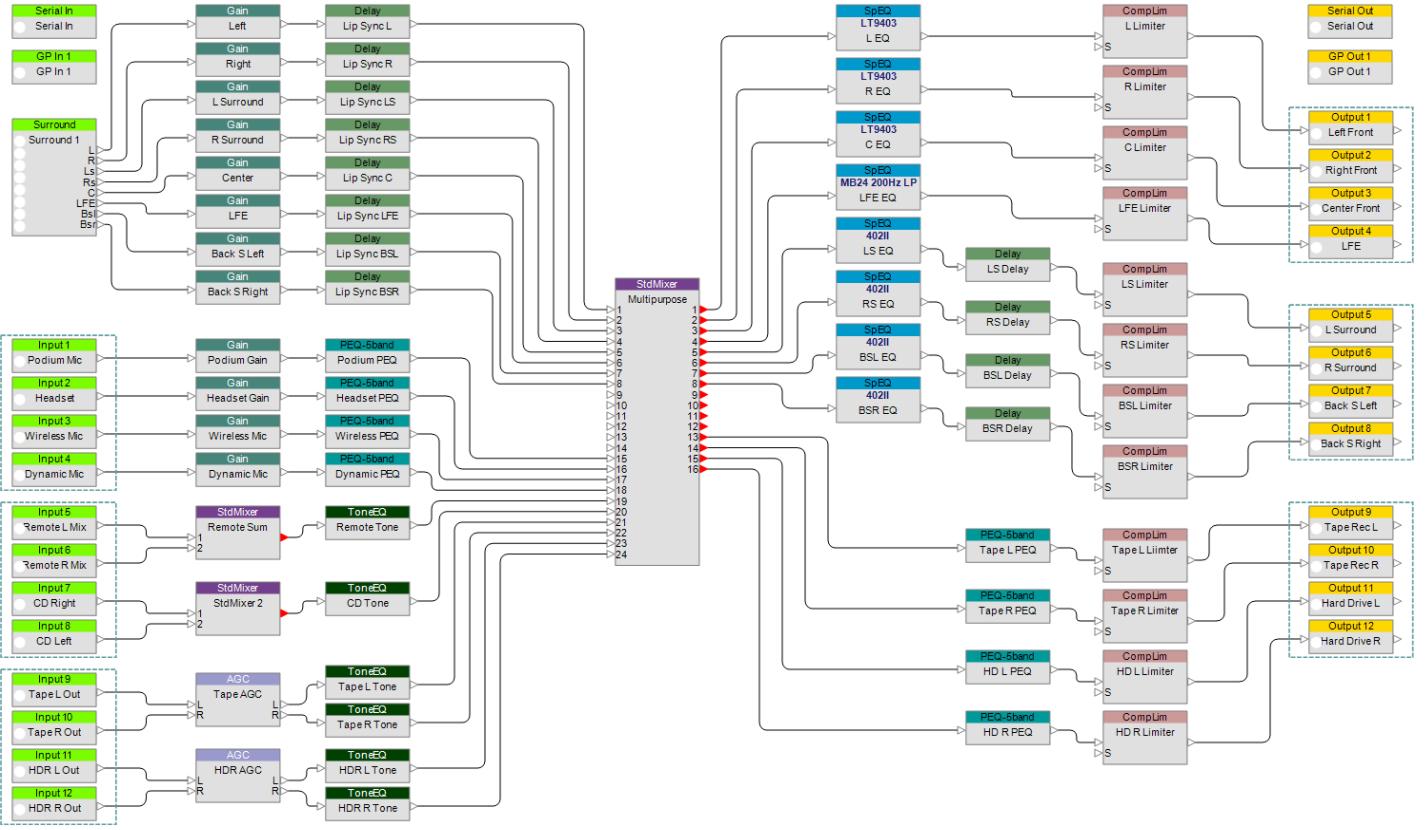
Figure 2: Digital Signal Processing configuration

Input Processing

The system's input processing comprises:

- Surround signal processing
- Signal conditioning
- Main mixing and routing

Surround signal processing monitors the digital audio bit stream for specific surround formats. The current list of supported formats is shown in Figure 3.

Bit Stream	C	R	L	Rs	Ls	LFE	Rb	Lb
Dolby Digital 1.0	✓							
Dolby Digital 2.0		✓	✓					
Dolby Digital 5.1	✓	✓	✓	✓	✓	✓		
DTS 1.0	✓							
DTS 2.0		✓	✓					
DTS 2/1		✓	✓	✓				
DTS 2/2		✓	✓	✓	✓			
DTS 3.0	✓	✓	✓					
DTS 4.0	✓	✓	✓	✓				
DTS 5.0	✓	✓	✓	✓	✓			
DTS 5.1	✓	✓	✓	✓	✓	✓		
DTS ES 6.1 Discrete	✓	✓	✓	✓	✓	✓	✓	✓
DTS ES 6.1 Matrix	✓	✓	✓	✓	✓	✓	✓	✓
PCM 16 bit (CD)		✓	✓					
PCM 24/48 bit		✓	✓					
DVD-Audio	✓	✓	✓	✓	✓	✓		
DTS-CDDA		✓	✓					

Figure 3: Currently supported surround sound formats

As unique bit streams are detected, the loudspeaker output channels automatically configure to match the unique surround sound format. This configuration adjustment is accomplished by defining unique parameter sets to match each type of surround sound signal anticipated.

Within ControlSpace systems, we use parameter sets to change the state of specific system adjustments without affecting the state of the entire design. Figure 4 illustrates the assignment of parameter sets in the media type programming area of the surround sound processing block.
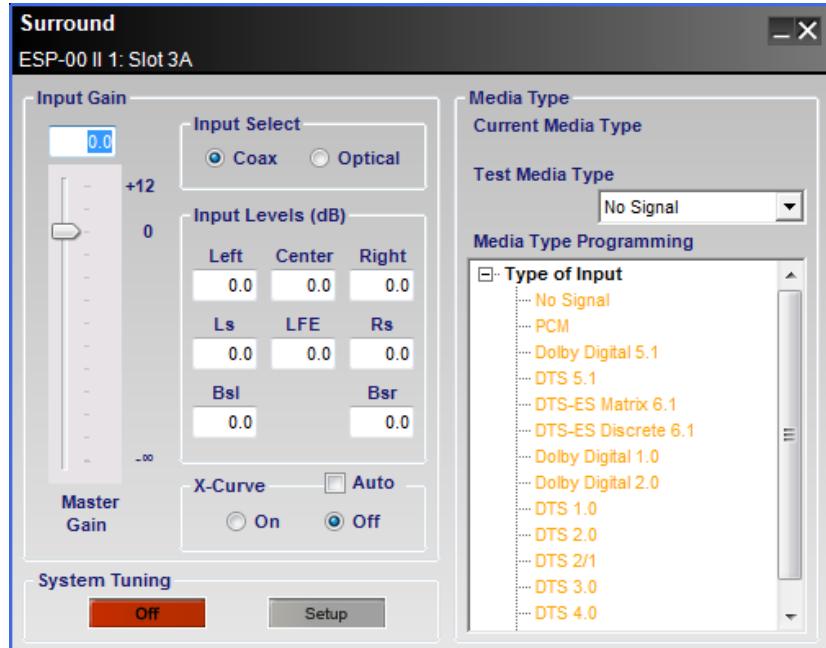

Figure 4: The surround card processing block

Signal conditioning provides individual gain stages for each surround sound card channel. Additional delay blocks are included to allow for compensation of audio synchronization issues with video content.
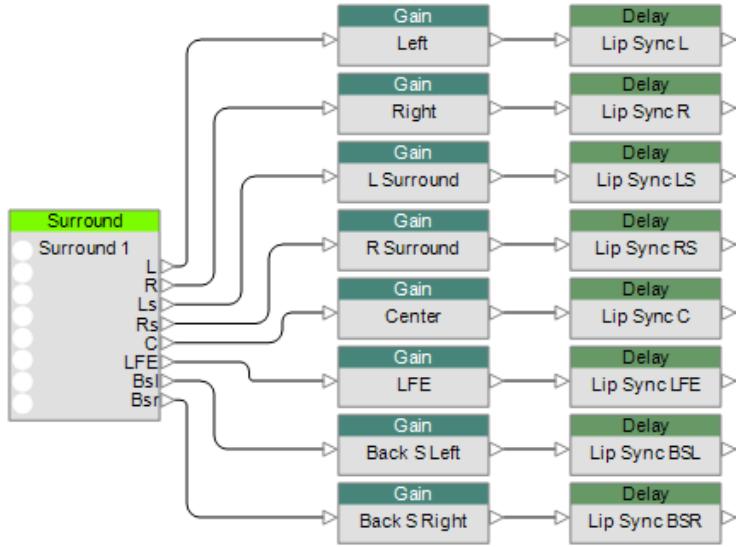
Figure 5: Surround sound channel processing

This system design also incorporates independent gain and equalization for each input channel. This streamlines system programming, allowing separate configurations for user-assigned gain controls on user interfaces. Each mic channel incorporates a 5 band parametric EQ.
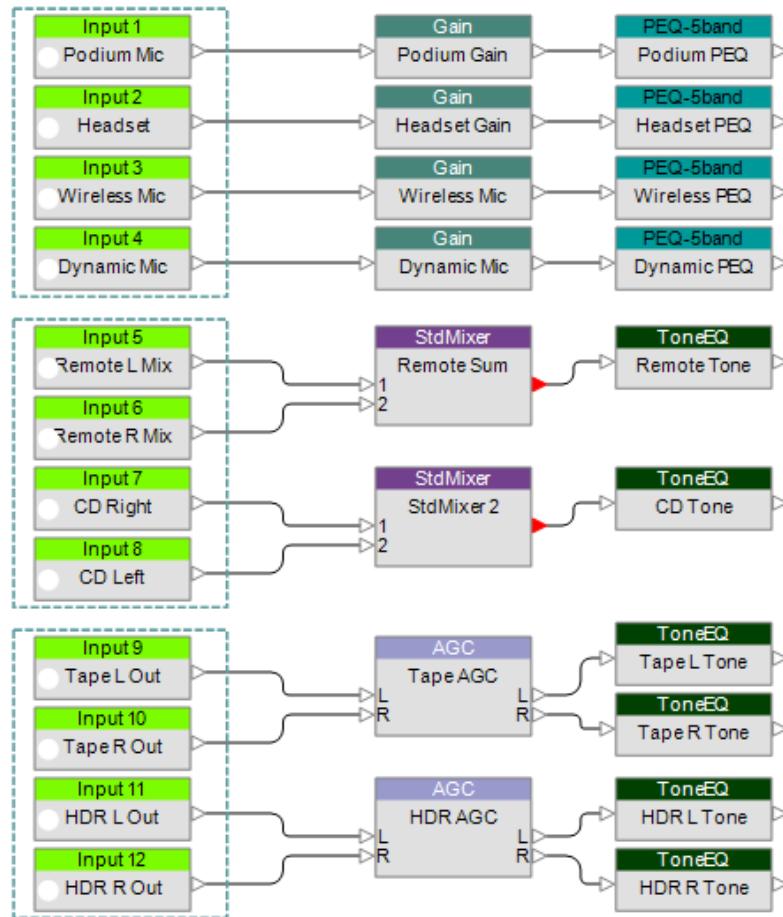
Figure 6: Independent volume and equalization for each microphone

The **main mixing and routing** section consists of a single large mixer and manages all system inputs through to the various output zones.
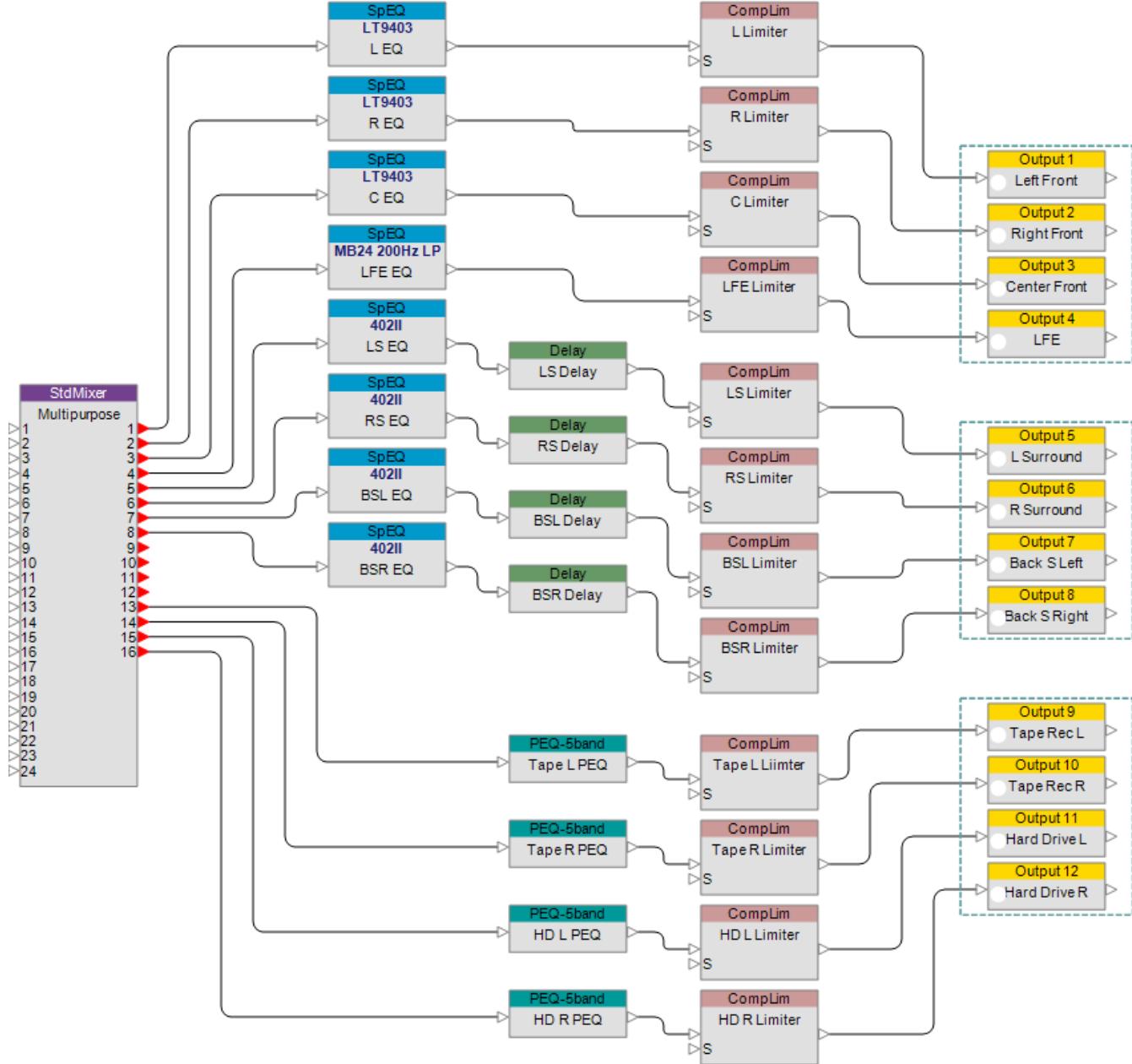
Figure 7: Main mixing, routing, and output processing blocks

Output Processing

This section of the design contains loudspeaker EQ, signal delay for surround sound zones, parametric equalization for recording devices, and protection limiters for each zone.

System Control

In this application note, we explored configuration of inputs, outputs, signal processing, mixing, and routing functions within this multi-purpose system. Now it is time to take the final step and discuss control programming for the system. We need to assign all the significant functions to the chosen user interface.

The design goal of this system dictates we use a single ControlSpace CC-64 Control Center to manage system functions.

The CC-64 is the flagship of our user interface offerings and supports the mapping of internal digital signal processing blocks, parameter sets, or groups, to the five rotary encoders included within the interface.
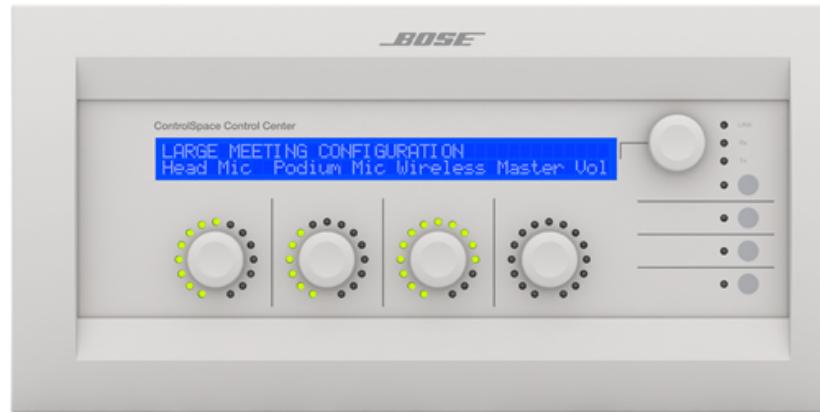
Figure 8: CC-64 Control Center

Four bank switching buttons on the CC-64, redefine a set of four Gain/Selector control knobs, providing quick access for up to 16 system gain controls or selectors. The 2-line by 40-character backlit LCD display of the CC-64 makes it easy to develop descriptive labels for controlled system elements.

Modes of operation within this multi-purpose system are numerous. Rotating the master selector of the CC-64, gives you the ability to scroll through available modes. When the desired mode is reached, simply push the encoder to activate that particular series of functions.

Here is a list of the modes currently defined for this system:

- Speech Mode
- Lecture Mode (Computer and Projector)
- Stereo Music Playback Mode
- Surround Music (DVD Audio and SACD Discs)
- Concert Mode with Performance Mixer
- Movie Mode
- Karaoke Mode

The displays visible by pressing the first three control bank switches are shown in Figure 9. Here you can see and control all significant system functions from a single interface.

Figure 9: CC-64 Control Center Functions (Banks 1-3)

With the surround sound decoder input card, loudspeaker configurations occur automatically regardless of whether you listen to 5.1, 6.1, or 7.1 content. This coupled with a CC-64 Control Center, makes for a Bose ControlSpace ESP system that is extremely easy to operate.

Summary

In this application note we examined the flexibility of Bose ControlSpace systems and the implementation of a design for a multi-purpose facility using a 7.1 channel surround sound loudspeaker layout.

This type of a system offers maximum flexibility for reinforcement of audio and video functions of greatest interest to young people.
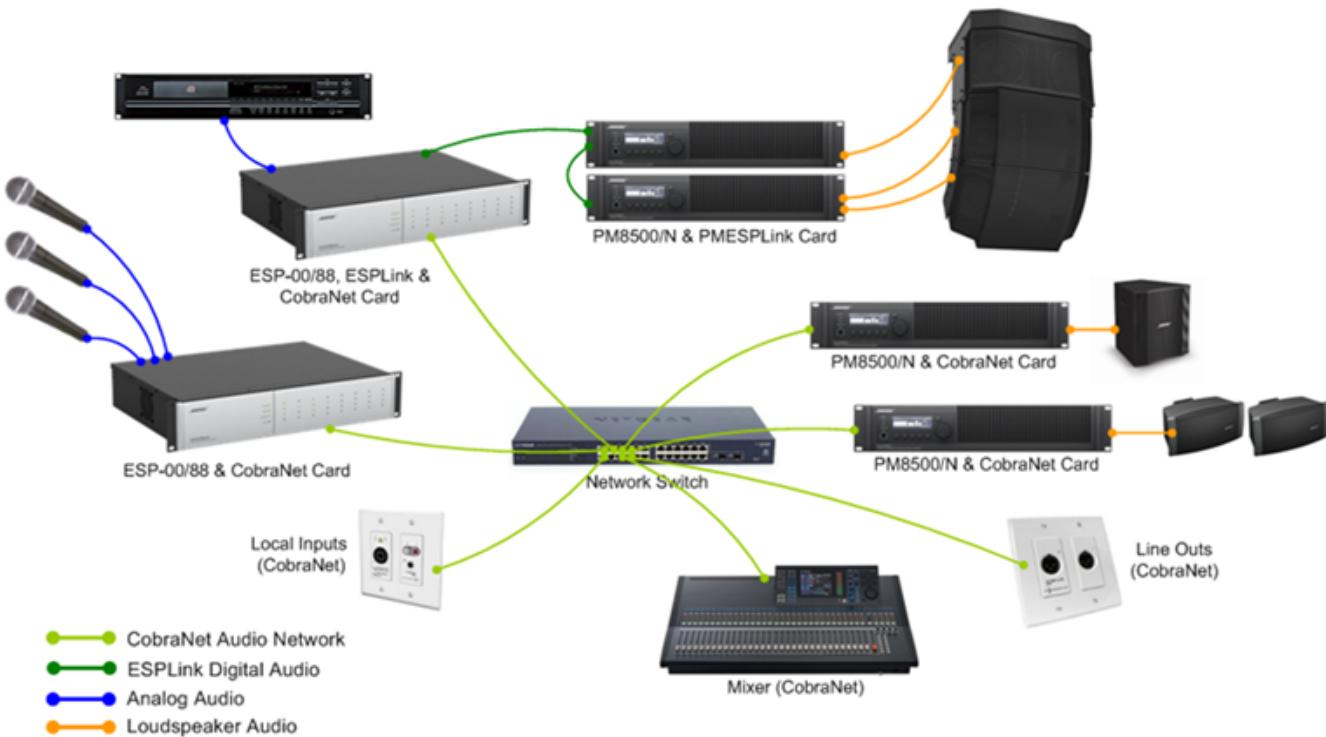
The ControlSpace surround sound decoder input card is an industry first by integrating a multi-purpose digital signal processor and a surround sound decoder within a single expansion card. This card works with DVD players, and facilitates multi-channel surround playback in our target markets for an enhanced listening experience.

To learn more about the Bose ControlSpace ESP engineered sound processor and the new surround sound decoder input card, please visit pro.Bose.com. Look for our related Surround Sound Design Guide for information about designing surround sound systems in large spaces.

CobraNet

CobraNet® Application Examples

CobraNet network audio expansion cards are available for both the ESP-88/00 engineered sound processors and the PowerMatch® configurable professional power amplifiers. The cards use industry-standard CobraNet technology to transport multiple channels of high quality, uncompressed digital audio in real time across a standard Ethernet network. CobraNet network audio distribution is typically used in systems which require signal processors and amplifiers that are in different parts of a large building or complex, or to interlink multiple devices within an equipment rack to reduce analog cabling and connections.
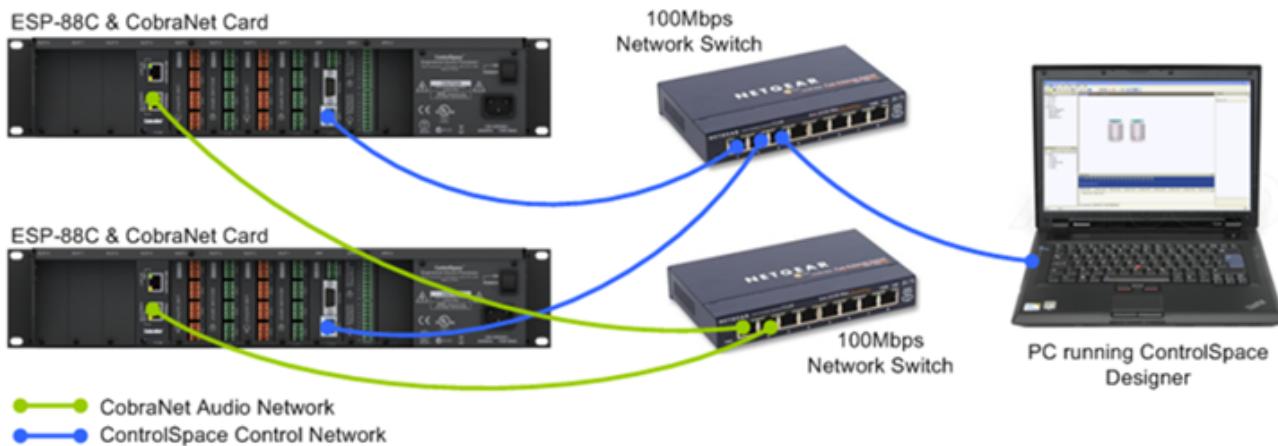
Example system using CobraNet network audio distribution

The following two examples explore several typical system configurations where a CobraNet audio network is used to distribute audio between signal processors and amplifiers.

- Example #1: ESP-to-ESP Signal Routing
- Example #2: Single ESP-to-Multiple PowerMatch Amplifiers

Example #1: ESP-to-ESP Signal Routing
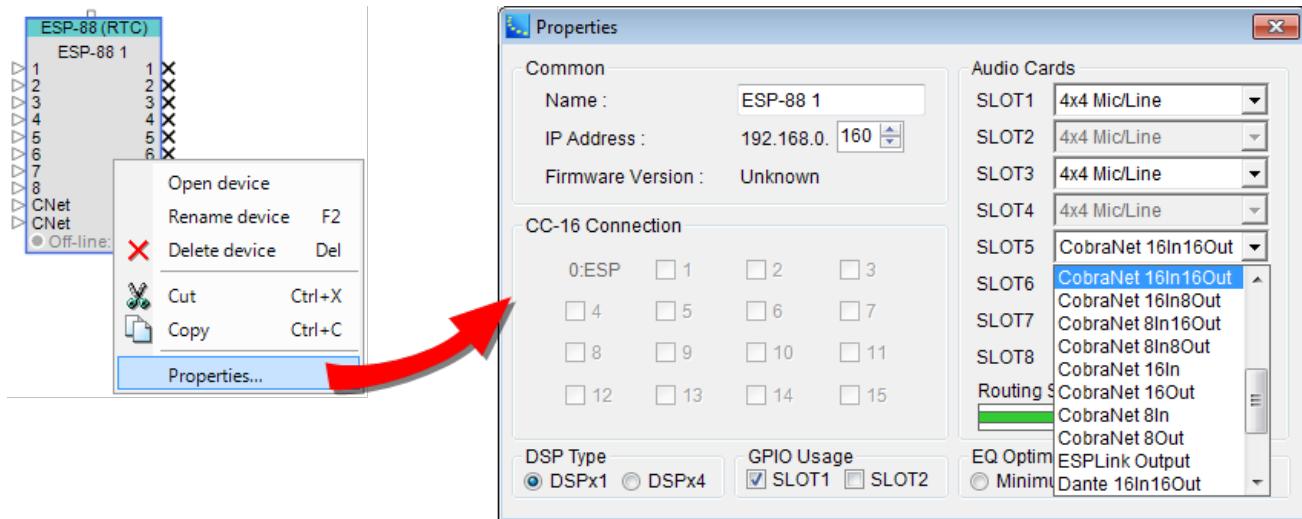
This first example includes two ESP-88s with eight channels of audio passing in each direction between them. This is a common application where the ESPs are physically separated, but act as the primary signal processor for their area. Each ESP provides a number of analog inputs for local sources, while the output section is used for local sound reinforcement. However, there is a need to make all input sources available to both areas, which is accomplished by routing the audio between the units using a CobraNet network.

*System configuration for ESP to ESP signal routing*
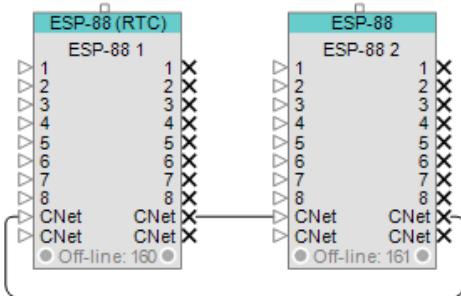
Note: Before following these steps to configure this example system it is assumed that a CobraNet card has been correctly installed into each ESP and that the independent networks have been created for CobraNet and the ControlSpace control network.

1. Using ControlSpace Designer v2.321 or later, create a new design file and perform a hardware Scan either by choosing the option from the Tools menu or by using the toolbar button, .

2. Assuming that all the network connections and settings are correct the two ESP-88s should be detected, populated with their standard 4x4 cards plus the additional CobraNet expansion card. By default the card will be shown as the '16 in, 16 out' variant unless there is an existing design file in the ESP with the card configured differently.

3. Since this system design only requires the CobraNet cards to have 8 inputs and 8 outputs the card can be configured as the '8 in, 8 out' variant, leaving four routing slots (three physical slots) available for other expansion cards. This can be changed in the ESP Properties window which is accessed by right-clicking on each ESP in Project View and selecting 'Properties'.
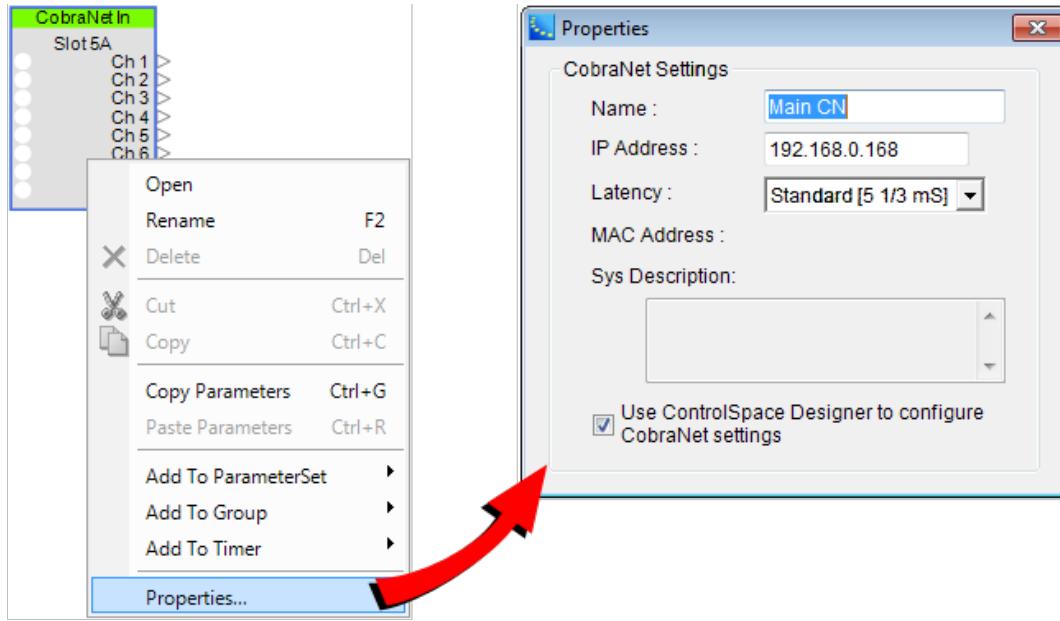
CobraNet configuration within ESP properties

4. Once the card variant has been changed it is recommended that the required connections between CobraNet transmitters and receivers are drawn in the Project View. While this has no influence on the actual operation it is a good visual reference of the CobraNet links that will be required.

CobraNet 'wiring' within the Project View
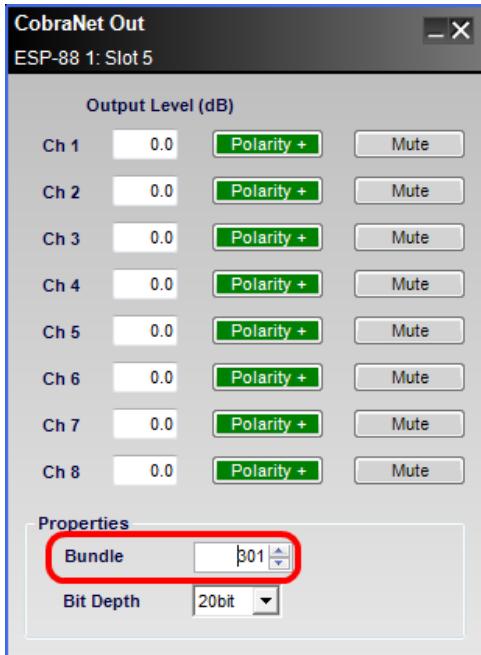
5. Verify the CobraNet configuration within the ESP. These options can be found in the Card Properties which are accessed by right-clicking on any CobraNet input or output module in ESP view and selecting 'Properties'. These are the default settings and should not require any changes.

CobraNet Input/Output Properties

6. You will now determine how audio will be routed between ESP-88 #1 and ESP 88#2, by creating a Bundle assignment for the output section of ESP-88#1. This Bundle assignment will determine the method used to broadcast the digital audio on the network. To accomplish this open the CobraNet output control panel within ESP-88#1.

   Once open, you can then assign a suitable Bundle number that will reference this group of eight channels. Since the connection is from a single transmitter (ESP-88 #1) to a single receiver (ESP-88 #2) a Unicast Bundle should be used from the range 256-65,279 to minimize network traffic.
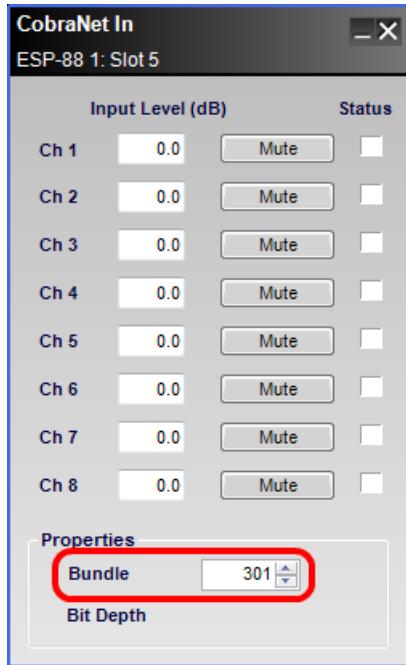
CobraNet Transmitter Bundle Assignment within ESP

NOTE: You can use any number within the Unicast range, 256-65,279, but typically it is easier to remember if it ends in '01' for the first link and '02' for the second link, (e.g. 301, 302 or 1001, 1002).

If desired the Bit depth can also be changed but the default of 20bit should be fine for most applications.
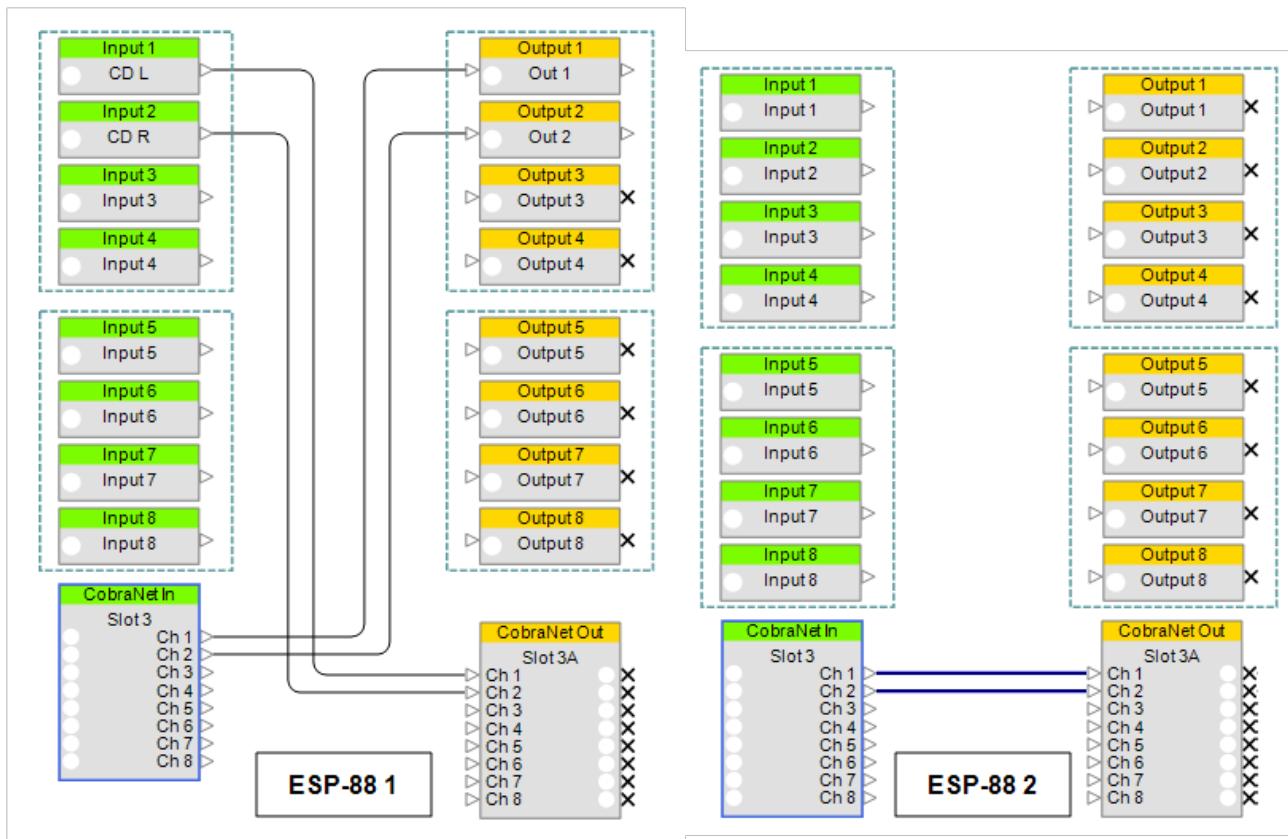
Now it is necessary to set up ESP-88 #2 to receive these 8 channels of audio. This is accomplished by configuring the CobraNet input of ESP-88 #2 to receive Bundle 301. Open the CobraNet input control panel in ESP-88 #2, and enter the new Bundle assignment.

*CobraNet Receiver Bundle Assignment within ESP*
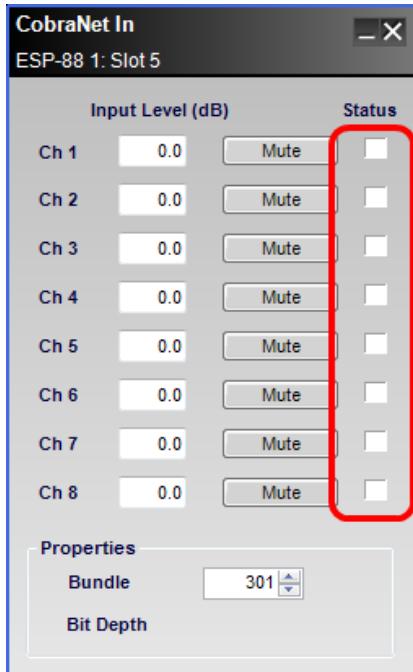
The previous two steps now need to be repeated to configure audio routing from ESP-88 #2 to ESP-88 #1. Note that the same Bundle assignment, 301 in this example, cannot be reused, and new Bundle assignment must be created, e.g. 302.

At this point the CobraNet configuration is complete and is ready, and once it is uploaded to the ESPs it should be possible to pass audio in both directions between them. To test this one could create a simple design using a source and a powered loudspeaker (or similar), passing the source to the second ESP and back again to prove that both connections are working.

Simple audio configuration to test CobraNet connectivity

In addition to monitoring the audio signal level or listening to the audio output, the correct operation of the CobraNet links can also be verified using the CobraNet Status indicators on the input modules. These are not audio signal indicators; instead they indicate the presence of valid CobraNet data for each channel. When ControlSpace Designer is on-line the indicators will be green if there is a valid CobraNet connection.
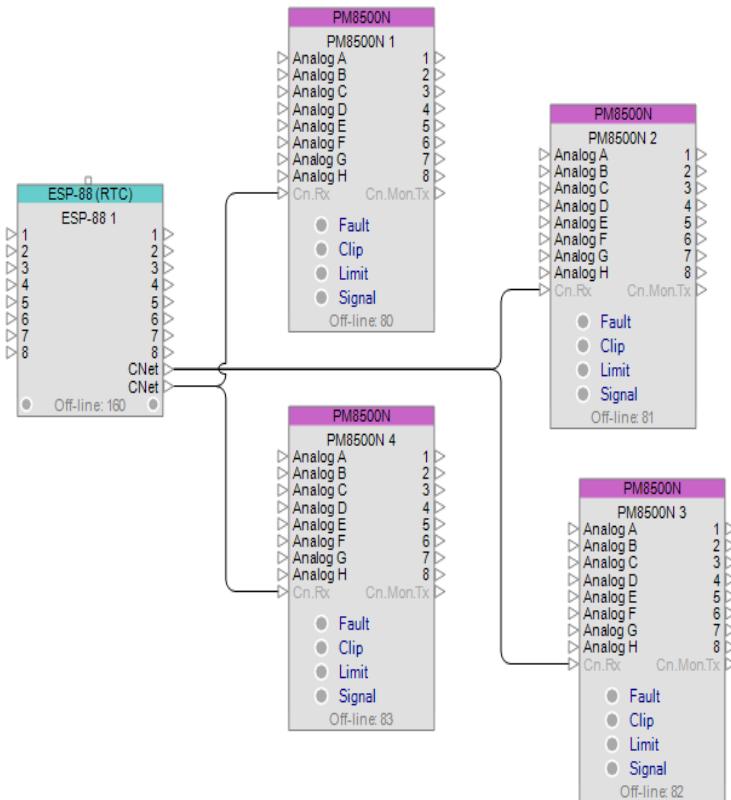
CobraNet In
ESP-88 1: Slot 5

	Input Level (dB)		Status
Ch 1	0.0	Mute	☐
Ch 2	0.0	Mute	☐
Ch 3	0.0	Mute	☐
Ch 4	0.0	Mute	☐
Ch 5	0.0	Mute	☐
Ch 6	0.0	Mute	☐
Ch 7	0.0	Mute	☐
Ch 8	0.0	Mute	☐

Properties
Bundle   301
Bit Depth

Black: Channel not being received

Green: Channel being received correctly

Red: Channel being received with errors (typically incorrect latency or network issues)

Example #2: ESP-to-Multiple PowerMatch® Amplifiers

In this more complex example, 2 Bundles and 16 channels of audio are distributed to two separate racks of Power-Match amplifiers. This is a typical application where the ESP is located in a primary control room, while the amplifiers are located remotely throughout the facility.

Example configuration for this example
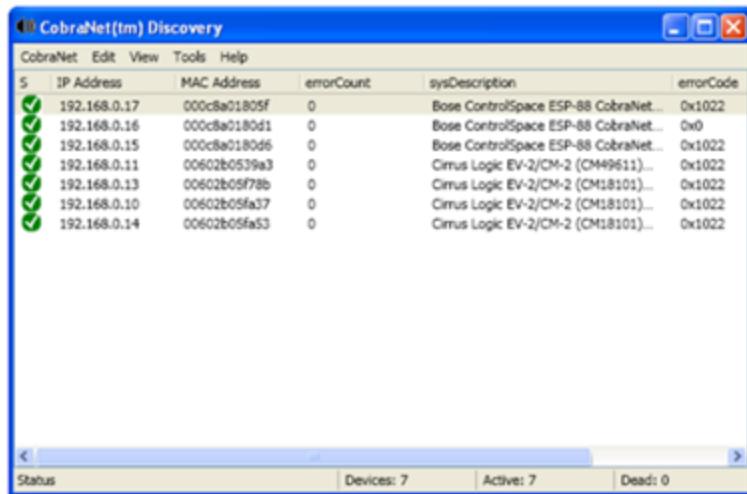
Since this example involves sending multiple Bundles to PowerMatch amplifiers, some configuration of the PM CobraNet cards using the CobraNet Discovery utility will be required.

To configure this system, follow these steps:

1. Install the CobraNet cards and hook up independent networks for the CobraNet audio data and the ControlSpace control data.

2. Open ControlSpace Designer, start a new file and perform a' Scan' of the hardware or add the ESP, PM amplifiers and CobraNet cards to Project View manually.

3. Select the ESP CobraNet card variant that most closely matches the project requirements in the ESP Properties. In this example it is configured as '16 out' so that two eight channel Bundles can be sent.

   The first transmitter will automatically be assigned Bundle number 100 (since it is the first CobraNet transmitter in the project), but the second transmitter will need to be assigned Bundle number 101 manually in the CobraNet Tx2 output module control panel.

4. Ensure that the ESP CobraNet card is set to 'Standard [5.33mS]' latency and that ControlSpace Designer has control over the CobraNet settings in the Card Properties (default settings).

5. Open the Input Control Panel for each PM amplifier and select 'Digital' source for each of the inputs.

6. Connect to the ControlSpace control network, send the design to the hardware and then disconnect.
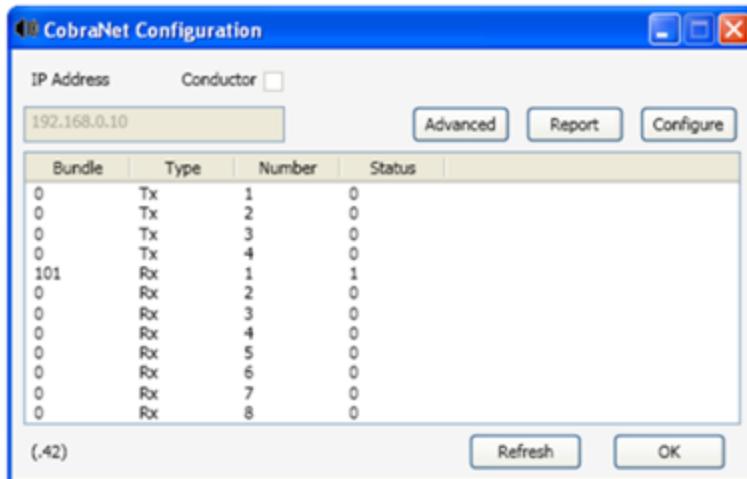
NOTE: Since the PM CobraNet cards come pre-configured, all amplifiers should be receiving audio, but the audio is intended for amplifiers 1 & 2. Changing the Bundle assignment for amplifiers 3 and 4 requires the use of the CobraNet Discovery utility.

7. Swap the PC network connection to the CobraNet network, launch the CobraNet Discovery utility and ensure that all five CobraNet devices are present.

CobraNet Discover device view

8. Identify the PM CobraNet cards by temporarily disconnecting each in turn, making a note of the MAC address associated with each amplifier.

9. Assign a valid IP address to each of the PM CobraNet cards (Remember that IP addresses are only temporary).

10. With the cards identified double-click on the card for amplifier #3 to open the 'CobraNet Configuration' dialog.
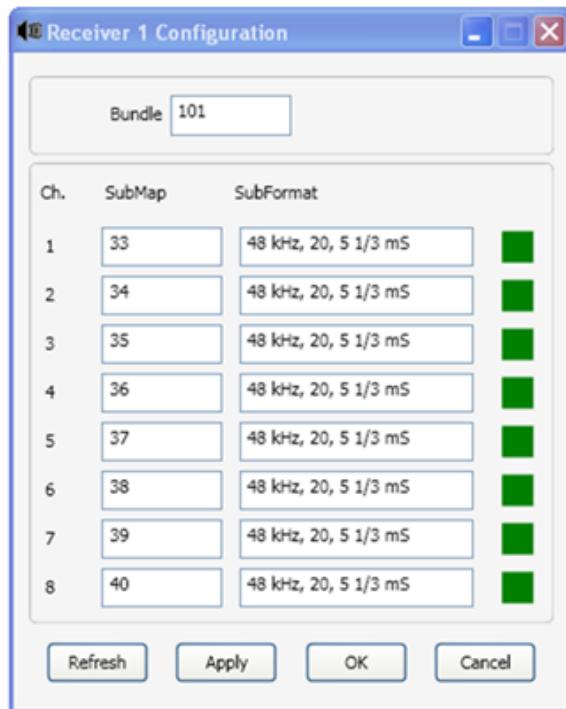
Configuration Parameters for PowerMatch amplifier

11. Then either select the row for Receiver 1 (Rx1) and click 'Configure' or simply double-click the row to open the 'Receiver 1 Configuration' dialog.

    Since the card is already receiving valid audio data (audio for amplifiers 1 & 2) the status indicators should be green.

12. Change the Bundle assignment from '100' to '101' and then click 'Apply'.

13. To verify that the card is now receiving valid audio data from the second transmitter on the ESP click 'Refresh' and ensure that the status indicators are still green.

Configuration Panel showing new Bundle assignment and on-line status
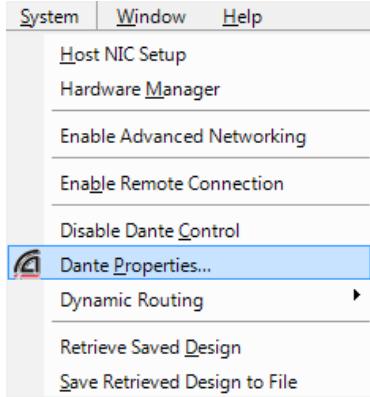
14. Repeat steps 1-13 for amplifier #4 and the system then be configured and working as expected.

Configuring Dante Networks
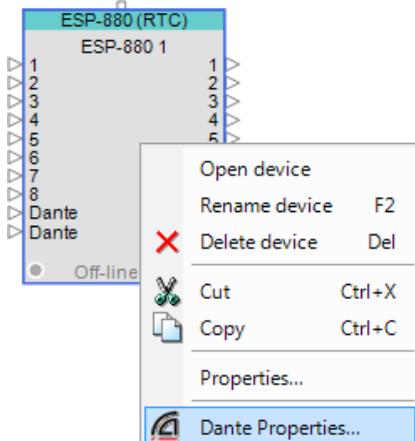
Dante™ Network Card Properties

The global **Dante Properties** control panel for a Dante network device is accessible in one of three ways:
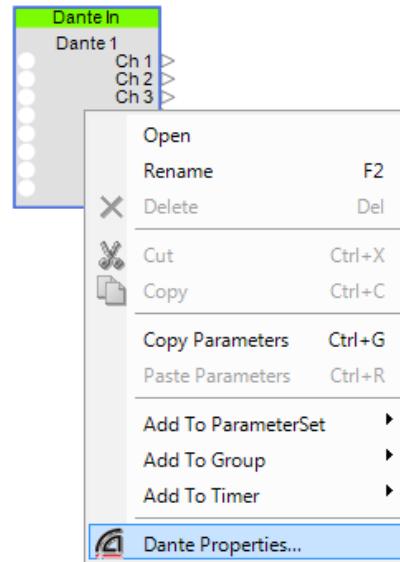
- In the System menu
- By right-clicking the device icon in Project View
- By right-clicking the Dante block in the Signal Processing View
- Clicking the Dante Properties button in the toolbar

Dante Properties
System Menu

Dante Properties
*Device Icon*

Dante Properties
Dante block
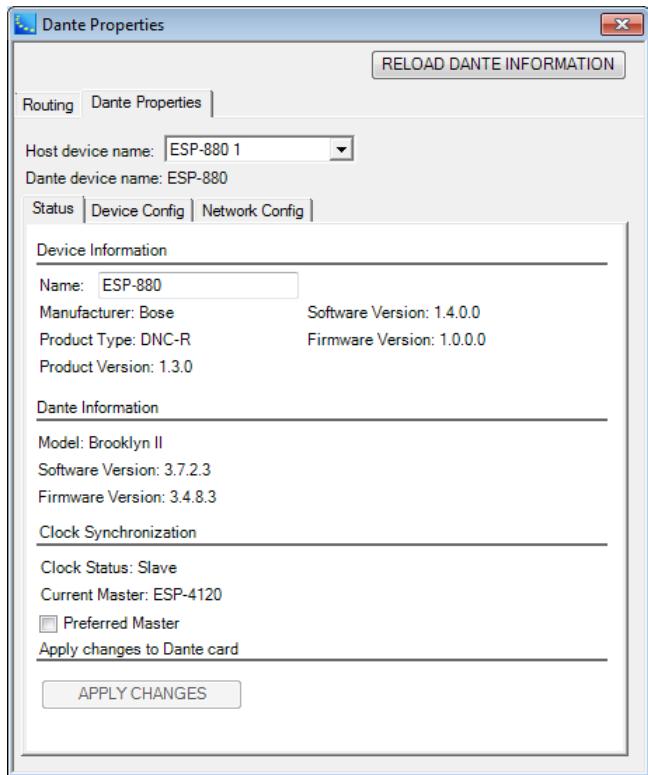
Dante Properties Button in Toolbar

Dante properties for the host device are organized under two main tabs: **Dante Properties** and **Routing**. The host device is selected in the **Host device name** drop-down list. The **Dante device name** is the name given to the Dante device installed in the host device. The **Dante device name** can be changed by entering a new name in the **Name** field under the **Status** tab.

NOTE: For information on programing Dante devices, see Programming with composite device blocks.
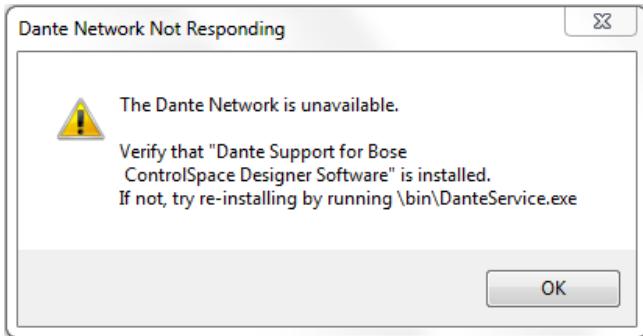
The **RELOAD DANTE INFORMATION** button at the top of the panel can be used to reload Dante network information from the selected host device.

Global Dante Properties Panel
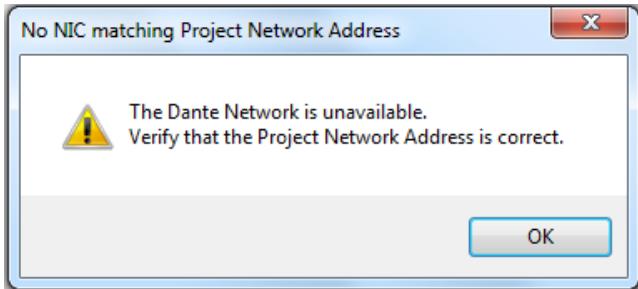
If Dante Properties information does not appear in this panel, you may see one or more error messages on your screen that indicates the Dante network is unavailable.

- If Dante services are not running:

   Dante network not responding message

- If the network interface address does not match the ControlSpace Designer software network address (see Project Network Address):
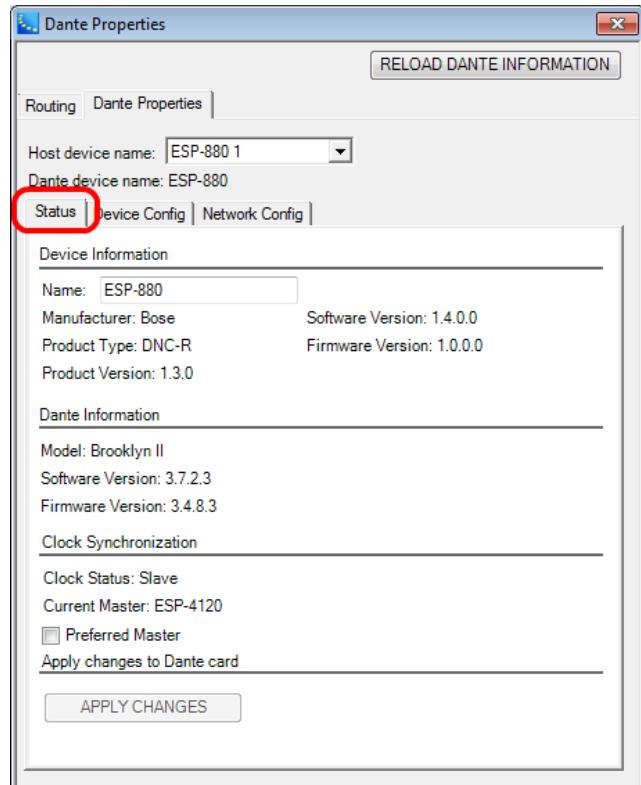
Project Network Address error message

Dante Properties Tab

Dante properties for the host device are organized under three tabs: **Status, Device Configuration** and **Network Configuration**.

Status Tab

The Status tab provides information about the Dante card located in the host device.

Dante Device Status

Device Information - Provides details about the host device. The **Name** field allows you to edit the Dante device name. After changing the name, be sure to click the **APPLY CHANGES** button.

UPDATE FIRMWARE - This button launches the Dante Firmware Update Manager which is used to update the firmware in Dante network devices (see Updating Firmware in Bose® Dante Network Cards). This button appears only when a firmware update is available.

Dante Information - Provides Dante software/firmware version details. Includes a notice when new firmware is available.

Clock Synchronization - Displays the clock status for the selected host device and the name of the device that currently provides the master clock. Selecting the **Preferred Master** check box prioritizes the named Dante device to be master.
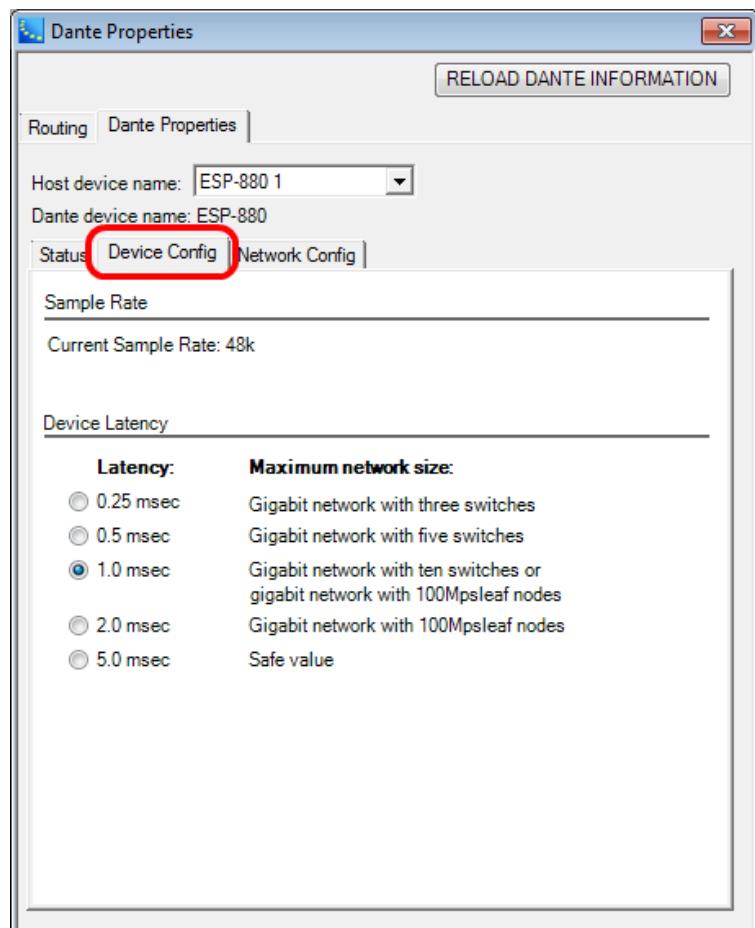
All Dante-enabled devices use the IEEE 1588 Precision Time Protocol (PTP) to synchronize their local clocks to a master clock.

One Dante device will be elected as the PTP Master Clock for the network; all other Dante devices act as a PTP Slave Clocks to the elected master clock. Although many Dante devices may be capable of becoming PTP Master Clock, only one device will win the election.

Sometimes it may be necessary to force a particular device to provide the PTP Master Clock. A Dante device with a **Preferred Master** option will always be chosen as the PTP Master Clock. If more than one device has a **Preferred Master** option, the device with the lowest MAC address will be chosen.
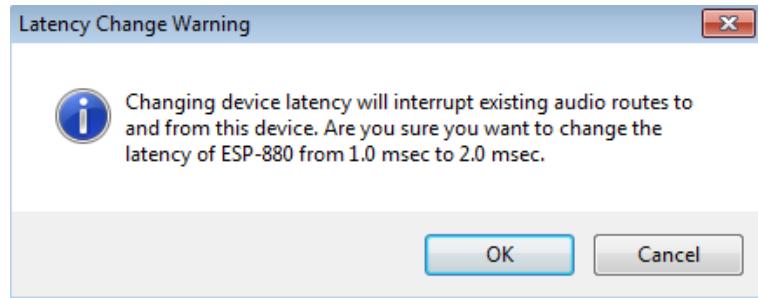
Device Config Tab

The **Device Config** tab displays the current **Sample Rate** and a list of selectable, recommended **Device Latency** settings for the host device. The typical default latency is 1 msec for a Dante device. A latency of 1 msec is sufficient for a very large network with a Gigabit network core and 100 megabit links to Dante devices. Smaller networks can use lower latency values.

Device Configuration Information
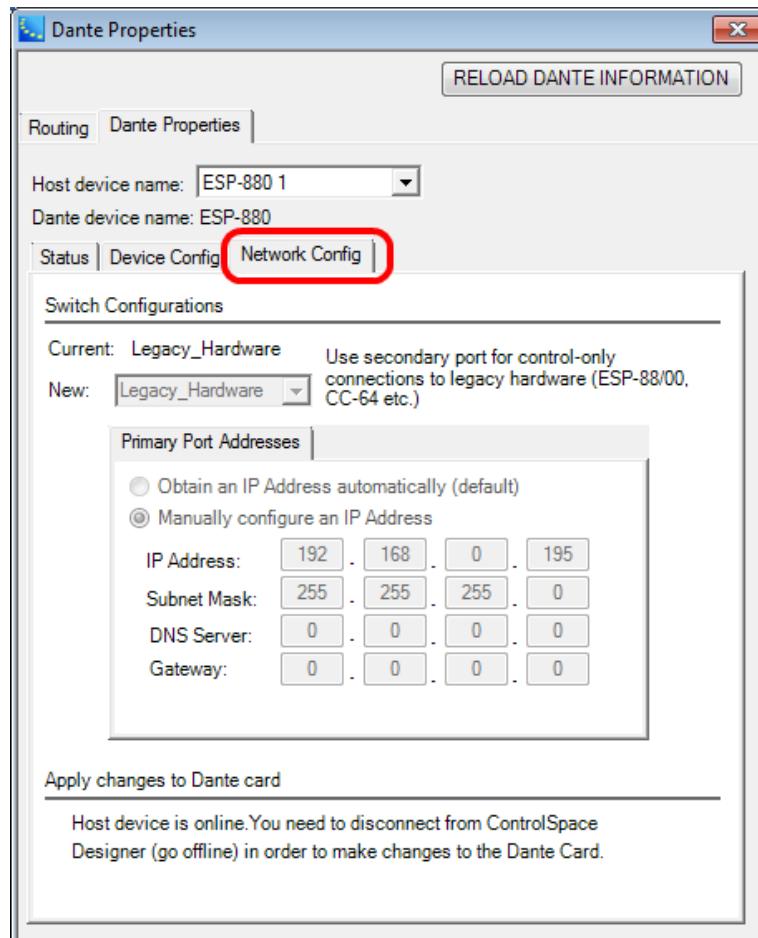
NOTE: Changing the Device Latency setting generates a warning dialog:

Click **OK** to make the change or click **Cancel** to leave the setting as is.

Network Config Tab

The **Network Config** tab provides access to the network configuration settings for the host device.

Dante Network Configuration Settings

Switch Configurations

    Current: - The current switch configuration setting for the Dante card.

New: - A drop-down list for selecting the port configuration.

Configuration	Primary Port Function	Secondary Port Function	Notes
Switched (Default)	ControlSpace control Dante audio	ControlSpace control Dante audio	Use secondary port for daisy-chaining devices.
Legacy Hardware	Dante audio	ControlSpace control	Use secondary port for control-only connections to legacy hardware such as the ESP-88/00 and CC-64.
Redundant	ControlSpace control Dante audio	Dante redundant audio	Use secondary port for a redundant audio network in critical installations.
Isolated Networks*	Dante audio	ControlSpace control	Use Primary port only for Dante Audio and Secondary port only for ControlSpace control.

Available only for ESP-880, ESP-1240, and ESP-4120 processors

Primary/Secondary Port Addresses - Selection determines how the IP address is set, automatically (default) or manually.

Apply changes to Dante card
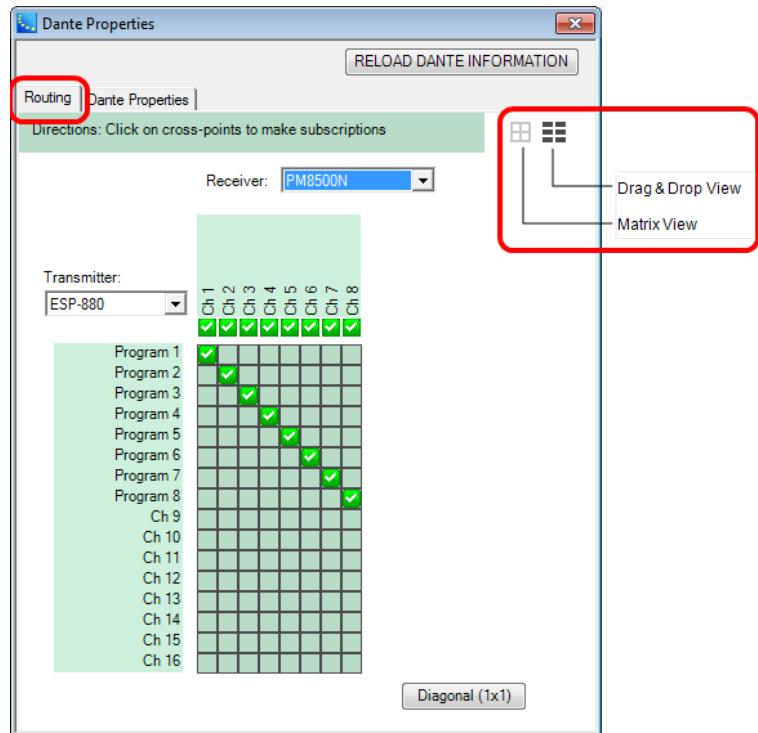
REBOOT TO APPLY CHANGES - Becomes active when changes are made. Click to reboot the Dante devices and apply changes.

NOTE: Changes can only be applied when the host device is offline.

Dante Network Routing

Dante network routing is configured within the **Routing** tab in the Dante Properties control panel.

Two views are available in the Routing tab: Matrix View (default) and Drag and Drop View . These views are selected by clicking the related icon in the upper right corner of the panel.

*Dante Properties Routing Tab*

Matrix View ⊞

The Matrix View allows you to configure subscriptions by just clicking.

A drop-down list of Dante-enabled **Transmitter** devices is found on the left of the matrix with transmitting channels listed vertically. A drop-down list of **Receiver** devices is on the top with receiving channels listed horizontally.

To make a subscription, click on the intersection of a transmitter channel and a receiver channel in the matrix. To delete a subscription, click on the channel intersection again.

The icon displayed at that intersection indicates the connection status:
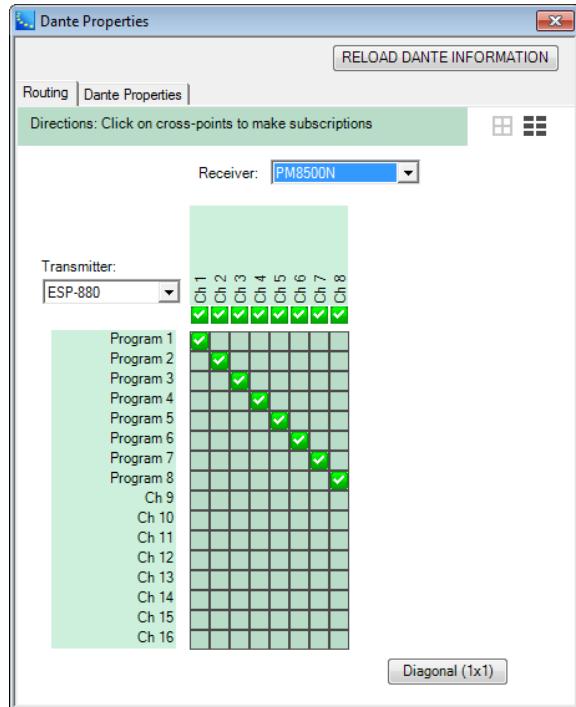
☐ No subscription

▦ Subscription connection in progress

✅ Subscription connection complete

⚠ Unresolved subscription

❌ Error

Dante Properties - Routing Matrix View

The Matrix view has the following features:

> **Transmitter:** - Selects the Dante transmitting device.

> **Receiver:** - Selects the Dante receiving device.
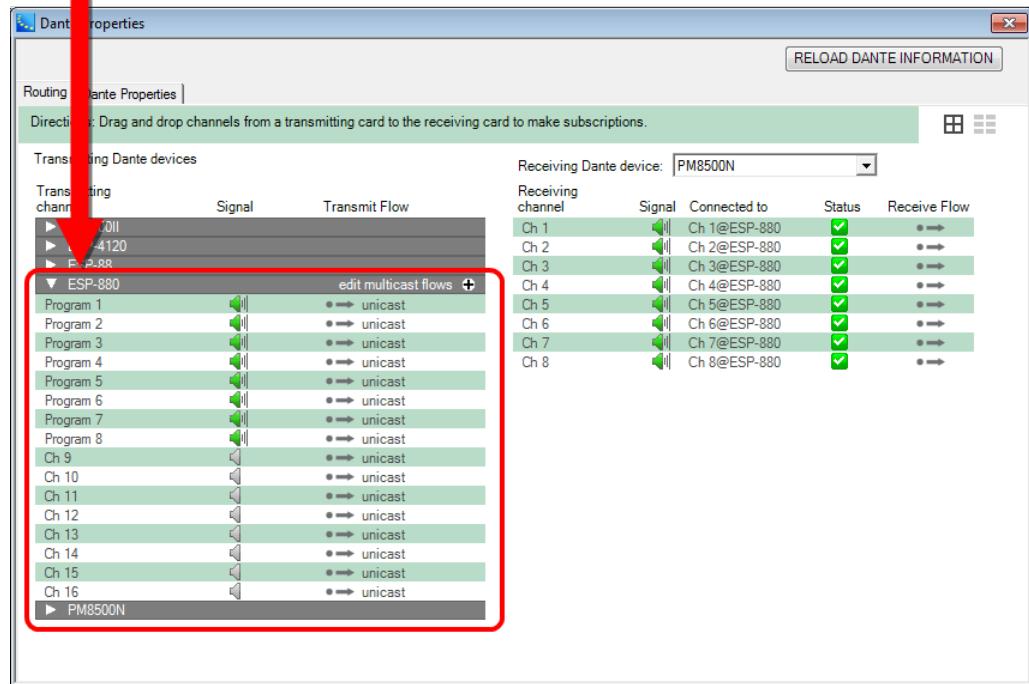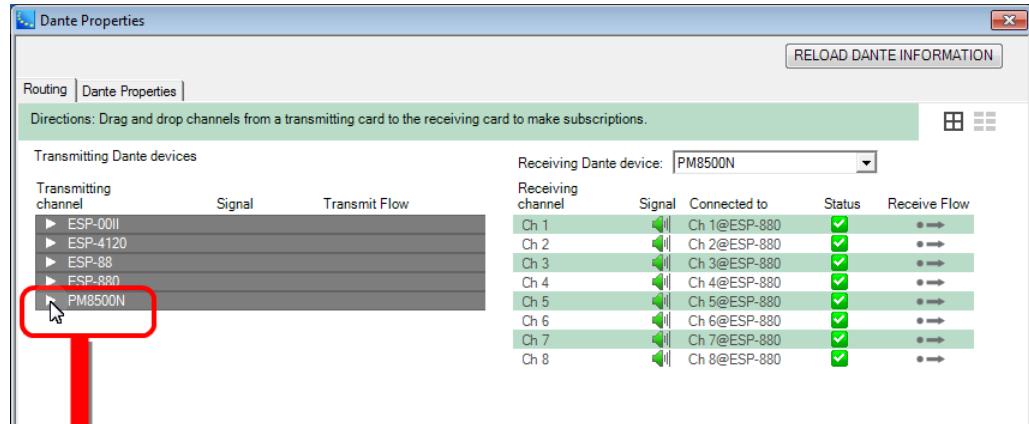
> **Diagonal (1x1)** - Makes 1x1 subscriptions diagonally across the selected receiving and transmitting devices. Click again to undo.

Drag and Drop View ⁚⁚

The Drag and Drop View allows you to configure subscriptions using the drag and drop method. Also, you can create and view unicast and multicast flows.

The Drag and Drop View shows the available **Transmitting Dante devices** and their channels on the left and the selected **Receiving Dante** device and its channels on the right.
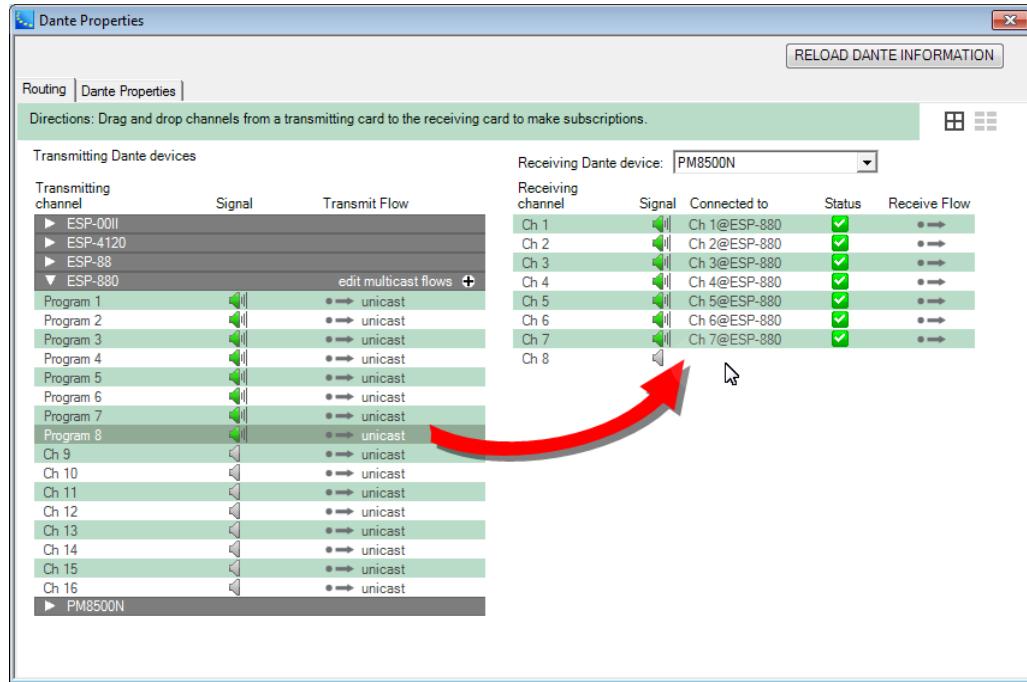
To view the transmitting channels, click on the arrow to the left of the device name.

Dante Properties - Routing Drag and Drop View

NOTE: To change the name of a channel, highlight the channel name, enter the new name and press Enter. The channel name is automatically updated in the Signal Processing View and, if applicable, in a multicast flow.

To make a subscription, click and drag a transmitting channel and drop it on a receiving channel.

Making a subscription in Drag and Drop View

The speaker icon indicates signal status:
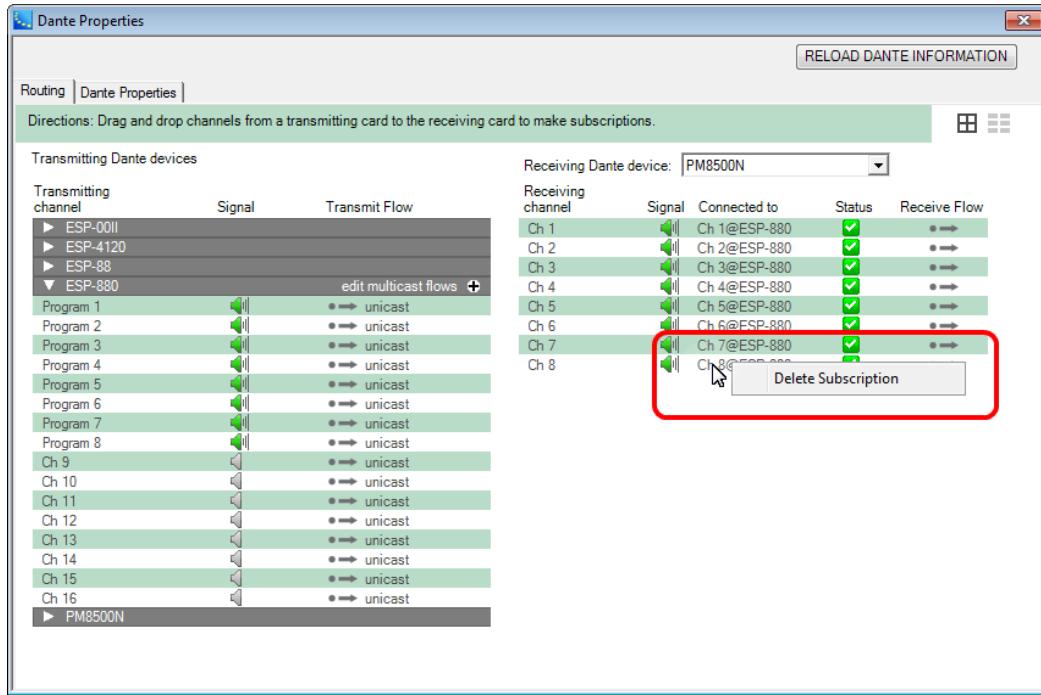
    Gray = No signal present, channel is muted, or receiving audio at less than −61 dbFS.

    Faded Gray = device does not support metering.

    Green = Channel is receiving audio between −61 dbFS and 0 dbFS.

    Red = Channel is clipping.

To remove a subscription, while hovering the cursor over the channel to delete, right click and then click **Delete Subscription**.
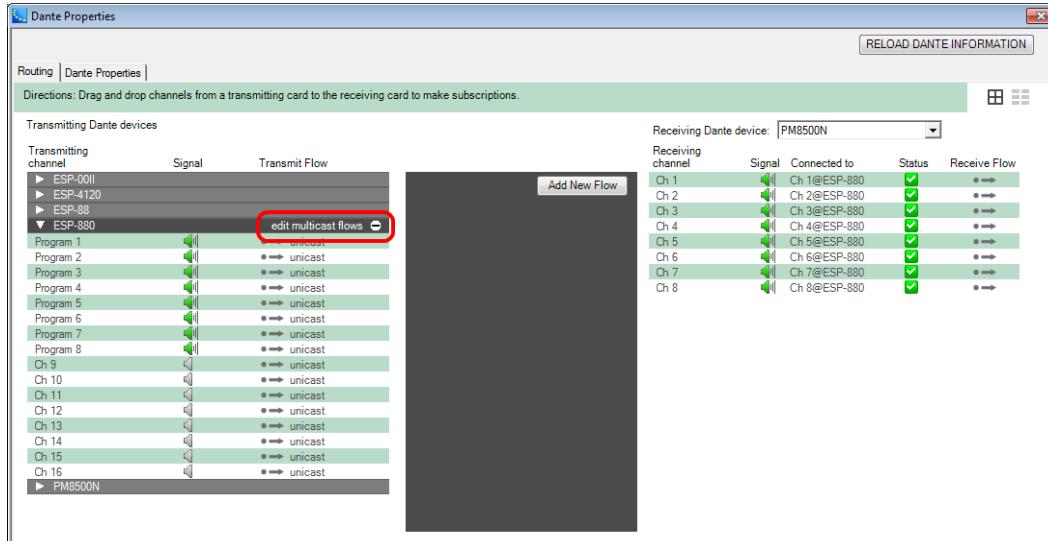
*Deleting a subscription in the Drag and Drop View.*

Multicast Flows
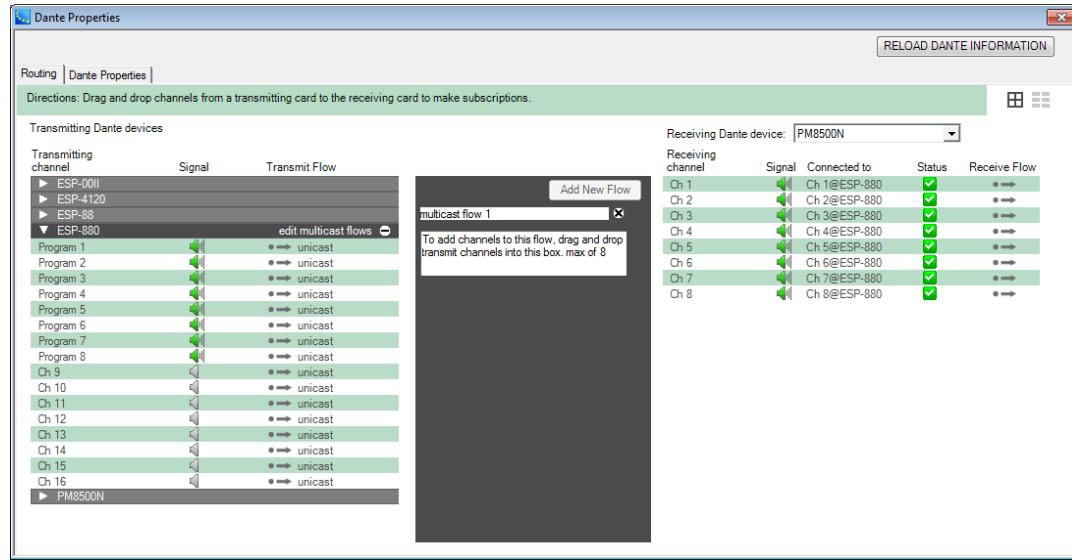
Routing Dante audio creates flows that carry one or more audio channels from a transmitting device to one or more receiving devices. A **Unicast** flow (default transmit flow) carries an audio channel to a single receiving device. A **Multicast** flow can be received by multiple receiving devices.

To add a new Multicast flow or edit existing ones, open the channel list for a transmitting device and click the plus icon ⊞ next to **edit multicast flows**. This opens the Multicast flow editing panel.
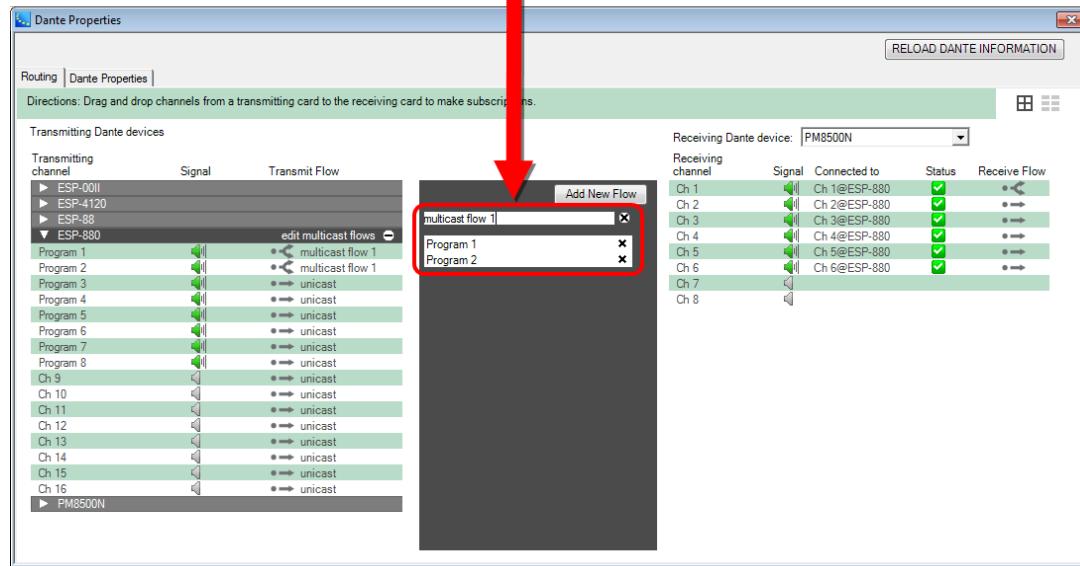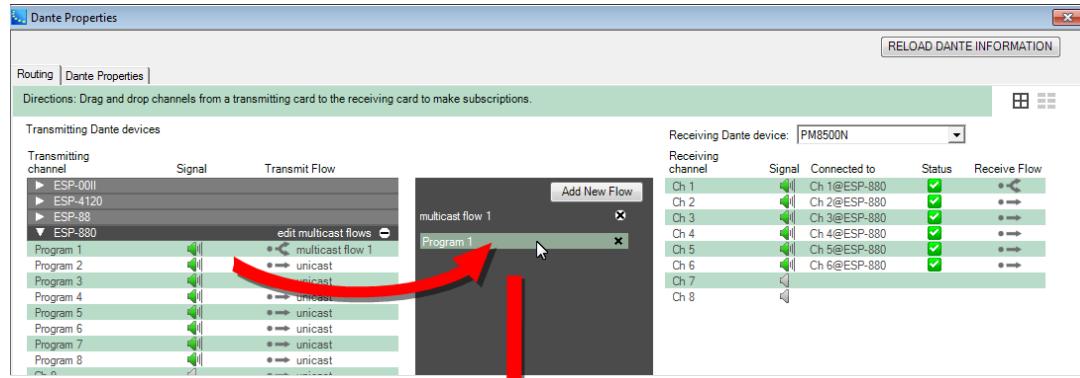

Opening the Multicast Editing Panel

Click the **Add New Flow** button. Text fields appear on the panel. The first field is the name of the flow which is editable. The second field defines the channels in the flow.

Multicast Panel Text Fields

To create a Multicast flow, click and drag a Transmitter channel into the panel.

Creating a Multicast Flow

To add another Multicast flow, click the **Add New Flow** button again.

To delete a channel in the flow or the entire flow, click the **X** to the right of the channel name or multicast flow name.

To close the panel, click the minus icon ⊟ next to **edit multicast flows**.

Notes:

- Unicast flows are not listed here, only multicast flows.
- Flows are created with the maximum number of channel slots for that device. For example, Bose Dante devices support 8-channel flows, so each flow created can hold up to 8 channels. The number of slots a flow can hold cannot be changed after it's been created.
- The number of possible flows is also dependent on the device type. Bose devices support up to 32 flows.
- You can only drag unicast flows into multicast flows. A channel can only be in one multicast flow at a time, no duplicates.
- You can rename flows by editing the text box above the channels.
- New flows cannot be added while there is already an empty flow in that device.

- Deleting a multicast flow may interrupt audio.
- It is preferable to use unicast flows for routing the same signal to up to four devices. For more than four devices it is better to use multicast flows, but then the data is sent to all devices irrespective of whether the audio channel is routed or not.